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THE ANTIGENIC PROPERTIES OF THE CHOLERA VACCINE PREPARED BY THE PHILIPPINE BUREAU OF SCIENCE.

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During the last thirty or more years vaccination against cholera has been practiced on a large scale in the Philippines. Although the results of the vaccinations have been apparently very successful from the practical standpoint, no laboratory data are available to demonstrate the immunological properties of the vaccine used. For this reason it was decided to undertake the study reported in this paper in accordance with the modern and apparently more accurate methods of testing the antigenic powers of bacterial organisms.

MATERIALS AND METHODS

COMPOSITION OF THE VACCINE

The cholera vaccine prepared by the Philippine Bureau of Science contains 3,000 million killed cholera vibrios per cubic centimeter suspended in physiological salt solution to which 0.5 per cent phenol is added as a preservative. The organism used was isolated several years ago from a fatal case of cholera in Manila and is known under the designation "Cholera strain No. 22."

BACTERIOLOGICAL STUDY OF CHOLERA STRAIN 22

This organism has been studied by Okamoto and Buñi,(6) who found that it is nonmotile and forms streptococcuslike

threads. My findings, however, do not correspond exactly with the observations of these writers. It is true that the organism appears to have lost its motility, but I find that it still retains the typical commalike appearance. In a few instances I have seen streptococcuslike threads in agar cultures, similar to those described by Okamoto and Buñi, but these I consider as involution forms.

When first transplanted from an agar culture the vibrio produces a general turbidity in peptone water, but does not form a pellicle. After several transplantations from peptone water to peptone water, it forms a white pellicle that easily falls to the bottom of the test tube. The organism produces a marked cholera-red reaction. As shown in Table 1 it fermented glucose, maltose, and saccharose, but not mannite. It was agglutinated by anticholera serum up to a dilution of 1 to 400.

TABLE 1.—*Sugar reactions of five strains of cholera vibrio.*

[Readings were made after incubation for twenty-four hours at 37° C.; +++ ++ indicate the relative intensity of the red color.]

Strain.	Glucose.	Mannite.	Lactose.	Saccharose.	Maltose.	Dulcite.	Xylose.	Russell. ^a
18784-1.....	+++	++	—	+++	+++	—	—	+++
1930-1.....	+++	+++	—	+++	+++	—	—	+++
1930-20.....	+++	++	—	+++	+++	—	—	+++
No. 22.....	+++	—	—	+++	+++	—	—	+++
656-46.....	+++	++	—	+++	+++	—	—	+++

^a Russell's double sugar medium.

The cholera strain used by the Philippine Bureau of Science in the preparation of vaccine thus differs from other known strains of cholera vibrio in two important respects; it is non-motile and does not ferment mannite. Whether or not these characteristics were originally possessed by the organism when it was first isolated is not known. By analogy it can only be surmised that it was a motile, mannite-fermenting vibrio but has lost these characters during the long years of its cultivation in artificial media. It would be interesting, therefore, to find out if its antigenic properties have been similarly affected.

OTHER STRAINS OF CHOLERA VIBRIO USED

In the study of the efficiency of the vaccine in question it is advisable to test it by means of the animal-protection test, not only against the homologous strain of organism used in the preparation of the vaccine but also against as many heterolo-

gous strains as are available. Four such strains are in the collection of the Bureau of Science and are designated 18784-1, 1930-1, 1930-20, and 656-46. These were isolated from cholera cases in different parts of the Philippine Islands. Morphologically they appear as short, slightly curved, actively motile spirilla. They ferment glucose, mannite, maltose, and saccharose and all of them give the characteristic cholera red-reaction. They were all agglutinated by anticholera serum in dilutions of 1 to 400 or higher (Table 2).

TABLE 2.—*Agglutination tests on five strains of cholera vibrio.*

[Readings after two hours at 37° C. in incubator and standing twenty-two hours at room temperature (28° to 29° C.).]

Locality.	Strain.	Dilution.				
		50	100	200	400	800
Iloilo.....	18784-1.....	++	+	+	±	—
Dumaguete.....	1930-1.....	++	++	+++	+++	+++
Bulacan.....	1930-20.....	+++	+++	+++	+++	+++
Manila.....	No. 22.....	+++	++	++	+	±
Cebu.....	656-46.....	+++	+++	+++	+++	++

Locality.	Strain.	Dilution.				Control.
		1,600	3,200	6,400	12,800	
Iloilo.....	18784-1.....	—	—	—	—	—
Dumaguete.....	1930-1.....	++	+	+	—	—
Bulacan.....	1930-20.....	++	++	+	—	—
Manila.....	No. 22.....	—	—	—	—	—
Cebu.....	656-46.....	++	+	+	±	—

PATHOGENICITY TESTS

The minimal lethal dose of each of the various strains of cholera vibrio used in this study was determined by injecting the live organisms intraperitoneally into guinea pigs weighing from 350 to 400 grams. A twenty- to twenty-four-hour alkaline agar culture was used in conducting the test and the same platinum loop was used for measuring the dosage of the inoculum. A suspension of the culture was made in physiological salt solution to contain the desired doses of the inoculum in 1 cc and the inoculated guinea pigs were kept under observation during the succeeding ten days. When the animals died, autopsy was always performed in order to make sure of the cause of death of the animals. In some animals a serofibrinous exudate was found in the peritoneal cavity, while in others the exudate

was hæmorrhagic. From such exudates vibrios were isolated using Dieudonne's medium.

The results of the virulence tests are given in Tables 3 to 7, in which it is shown that the minimal lethal dose of strain 18784-1 is one-tenth of a loopful; of strain 22, three loopfuls; of strain 1930-1, three loopfuls; of strain 1930-20, two loopfuls; and of strain 656-46, two loopfuls. It appears from these results that no relation exists between the virulence of an organism and its immunologic properties as indicated by its agglutination reaction. Referring to Table 2, it has been observed that strains 18784-1 and 22 behave in the same manner towards immune serum, the highest agglutinating dilution for both being 1 to 400; and yet the pathogenicity of strain 18784-1 has been found to be about thirty times that of 22. The other three strains agglutinated in dilutions as high as 1 to 6,400 and they showed more or less the same degree of virulence. According to Kabeshima's classification(5) strains 18784-1 and 22 would belong to the so-called "original type" and the other three strains to the "varied type." In this connection it may be asked: Is it a property of the varied types of cholera vibrio to exhibit more or less uniformity in virulence?

TABLE 3.—Virulence tests on strain 18784-1

[D12, death within twelve hours after inoculation; S, survived.]

Date.	Dose.	Guinea pig No.—					
		13	14	15	16	17	18
	Loopfuls.						
November 6.....	2	D12	D12				
November 8.....	1			D24	D24		
November 8.....	$\frac{1}{2}$					D24	D24
November 13.....	$\frac{1}{2}$						
November 16.....	$\frac{1}{10}$						
November 20.....	$\frac{1}{20}$						

Date.	Dose.	Guinea pig No.—					
		19	20	21	22	23	24
	Loopfuls.						
November 6.....	2						
November 8.....	1						
November 8.....	$\frac{1}{2}$						
November 13.....	$\frac{1}{2}$	D24	D24				
November 16.....	$\frac{1}{10}$			D24	D24		
November 20.....	$\frac{1}{20}$					S	D36

TABLE 4.—*Virulence tests on strain 22.*

[D12, death within twelve hours after inoculation; S, survived.]

Date.	Dose.	Guinea pig No.—											
		1	2	3	4	5	6	7	8	9	10	11	12
	<i>Loopfuls.</i>												
October 11.....	$\frac{1}{4}$	S	S										
October 11.....	$\frac{1}{2}$			S	S								
October 11.....	$\frac{1}{4}$					D24	S						
October 11.....	1							S	S				
October 30.....	2									D24	S		
October 30.....	3											D12	D6

TABLE 5.—*Virulence tests on strain 1930-1.*

[D12, death within twelve hours after inoculation; S, survived.]

Date.	Dose.	Guinea pig No.—					
		25	26	27	28	29	30
	<i>Loopfuls.</i>						
November 26.....	1	D24	S				
December 4.....	2			D12	S		
December 6.....	3					D12	D12

TABLE 6.—*Virulence tests on strain 1930-20.*

[D24, death within twenty-four hours after inoculation; S, survived.]

Date.	Dose.	Guinea pig No.—			
		35	36	37	38
	<i>Loopfuls.</i>				
December 15.....	1	S	S		
December 21.....	2			D24	D24

TABLE 7.—*Virulence tests on strain 656-46.*

[D24, death within twenty-four hours after inoculation; S, survived.]

Date.	Dose.	Guinea pig No.—			
		31	32	33	34
	<i>Loopfuls.</i>				
December 11.....	1	S	D24		
December 13.....	2			D24	D24

METHOD OF IMMUNIZATION

AGGLUTININ PRODUCTION

Having observed the marked immunizing powers of the Bureau of Science cholera vaccine, I decided to test the agglutinating titer of the serum of the vaccinated guinea pigs for strain 22. For this purpose four of the inoculated animals were bled from the heart and the serum was collected and stored in the refrigerator until ready for use. An emulsion of a twenty-four-hour alkaline agar culture of strain 22 was prepared by adding to the culture 3 cc of physiological salt solution containing 0.5 per cent phenol. Serum dilutions obtained from the guinea pigs were made and distributed in 1-cc amounts in test tubes. One drop of the vibrio emulsion was added to every tube. Controls were set up using normal guinea-pig sera. Readings were made after incubation for two hours at 37° C. and also after standing for twenty-two hours at room temperature (28° to 29° C.). The results are shown in Tables 9 and 10.

TABLE 9.—*Agglutination tests with serum of vaccinated guinea pigs.*

Guinea pig No.—	Dilution.							Control.
	25	50	100	200	400	800	1,600	3,200
43.....	++	++	+++	+++	+++	++	—	—
48.....	++	++	+++	+++	+	—	—	—
53.....	++	++	+++	++	+	—	—	—
59.....	++	++	+++	++	+	—	—	—

TABLE 10.—*Agglutination tests with serum of normal guinea pigs.*

Guinea pig No.—	Dilution.					Control.
	25	50	100	200	800	
61.....	+	—	—	—	—	—
62.....	+	—	—	—	—	—
63.....	—	—	—	—	—	—

The sera of all the vaccinated guinea pigs agglutinated in a dilution of 1 to 400, the serum of guinea pig 43 also agglutinated in 1 to 800 dilution. The sera of only two of the control normal guinea pigs gave agglutination in 1 to 25 dilution, the serum of the third normal guinea pig producing no agglutination in any of the dilutions made. The remarkable agglutinin-producing power of the cholera vaccine is thus evident from these observations.

Tests for agglutinin production were also made on guinea pigs that received intraperitoneally $\frac{1}{4}$ - and 1-loopful doses of live organisms of strain 22. The tests were made ten days after inoculation. Table 11 shows the results obtained.

TABLE 11.—*Agglutination tests with serum of guinea pigs inoculated with live cholera vibrios.*

Guinea pig No.—	Dose.	Dilution.							Control.
		25	50	100	200	400	800	1,600	
	<i>Loopfuls.</i>								
1.....	$\frac{1}{4}$	++	++	++	+	—	—	—	—
2.....	$\frac{1}{4}$	++	++	++	+	—	—	—	—
7.....	1	++	++	+	—	—	—	—	—
8.....	1	++	++	++	+	—	—	—	—

In like manner the agglutinating power of the sera of the guinea pigs that received both cholera vaccine and lethal doses of strain 22 was also determined. The tests were made ten days after the injection of the lethal dose.

The results are given in Table 12.

TABLE 12.—*Agglutination tests with serum of vaccinated guinea pigs that survived lethal doses of live cholera vibrios.*

Guinea pig No.—	Dilution.										Control.
	25	50	100	200	400	800	1,600	3,200	6,400	12,800	
44.....	++	++	+++	+++	+++	+++	++	+	—	—	—
45.....	++	++	+++	+++	++	+	+	—	—	—	—

A comparison of the results obtained, as shown in Tables 9, 11, and 12, brings out the following facts:

(a) Agglutinin production in guinea pigs by the intraperitoneal injection of living cholera vibrios is not as marked as when cholera vaccine is inoculated three times intraperitoneally.

(b) On the other hand it is very marked when a lethal dose is injected after three doses of cholera vaccine, the agglutinating power of the serum being three to four times as great as when cholera vaccine alone is injected three times.

(c) Although the agglutinating power of a serum is not alone responsible for its immune properties, nevertheless, the fact that after inoculation of cholera vaccine the agglutinating

titer rose to as much as five or six times the normal titer and the fact that the large majority of the vaccinated animals survived lethal doses of live cholera vibrios make it reasonable to suppose that agglutinins play no mean rôle in determining resistance against the live organisms.

SUMMARY AND CONCLUSIONS

1. The cholera vibrio (strain 22) used in the preparation of the cholera vaccine by the Bureau of Science possesses two characteristics which render it unique; namely, inability to ferment mannite and nonmotility.

2. The Bureau of Science cholera vaccine was shown by laboratory tests to possess marked antigenic powers and to protect effectively against various strains of cholera vibrio.

3. No relation was found between the virulence and the immunological group of cholera vibrio. In a given group some strains are very virulent, while others are very weak.

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NITRIFICATION IN ACID SOILS

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The acidity of soils in relation to the activities of nitrifying organisms is a problem of vital importance because of its direct bearing upon the crop-producing power of the land.

This report gives the results of an investigation on the nitrification (nitrate production) in acid soils.

A number of researches have been carried out to determine the conditions responsible for this particular kind of nitrification.⁽¹⁻¹²⁾ Theoretically nitrification processes can only take place in a neutral or alkaline medium under controlled conditions. However, it is not uncommon to find nitrate production occurring in acid soils. For example, Temple⁽²¹⁾ reported that nitrification was active in a soil which had a lime requirement of 5,000 pounds per acre.

Some of the European workers who have observed nitrification in a distinctly acid soil claim that there exists in the soil a strain or strains of nitrifying acid-resisting bacteria. Others claim that the organisms concerned in the process of nitrification can be made to grow in media of different reactions by gradual adaptation.

EXPERIMENTAL PROCEDURE

The effect of acidity on nitrifying soil organisms.—Experiments were first carried out to ascertain the critical acid concentration that would inhibit the activity of nitrifying organisms in the soil.

The soil used was a brown silt loam with very low lime requirement (0.009 per cent equivalent calcium carbonate) as determined by Hopkins's method for soil acidity.⁽¹⁴⁾

The experiments were made in series, each of which represented certain acid concentrations. For each series there were twelve cultures of treated soil contained in Erlenmeyer flasks. In each flask there was a quantity of soil that was equivalent to 100 grams of water-free soil. This was treated with dilute sulphuric acid to obtain the percentage of acidity desired. The

soil and acid were thoroughly mixed and set aside for one week to insure as complete diffusion of acid in the soil as possible. Ammonium sulphate (0.2 gram) was then mixed with the acidified soil and enough water was added to get a moisture content of 60 per cent. The cultures were incubated for twenty-eight days at ordinary tropical room temperature (25° to 30° C.). The water content of the soil was kept constant during the period of incubation. After incubation nitrate-nitrogen determinations were made for ten cultures of each series using the modified phenol disulphonic method.(13,17) The remaining two cultures were used for soil acidity determinations, employing Hopkins's method. The results of the experiments (Table 1) represent the average for each series.

TABLE 1.—*Effect of different concentrations of acid on the activity of nitrifying organisms in the soil.*

Series.	Nitrate nitrogen per 100 g of soil.		Added nitrogen nitrified.	Acid.	
	Control soil.	Soil treated with 0.2 g ammonium sulphate.		At the beginning.	After 28 days.
	mg.	mg.	Per cent.	Per cent.	Per cent.
1.....	Nil.	Nil.	Nil.	1.71	1.00
2.....	Trace.	Trace.	Trace.	0.80	0.53
3.....	0.015	0.315	0.71	0.60	0.20
4.....	0.014	0.29	0.66	0.40	0.06
5.....	0.192	4.00	9.06	0.20	0.02
6.....	0.760	15.94	36.14	0.08	0.015
7.....	1.120	23.46	53.19	0.06	0.013
8.....	1.830	27.93	63.33	0.04	0.011
9.....	1.700	36.00	81.66	0.02	0.008
10.....	1.904	40.00	90.70	0.009	0.005

The results (Table 1) show that there was only a slight degree of nitrification in a soil having 0.8 per cent acidity, but as the acidity decreased the nitrate production increased. For a medium with 1.71 per cent acid there was no nitrification. The medium, having 0.009 per cent acid, converted into nitrate 90.70 per cent of the nitrogen added.

These data also bring out the fact that the initial acidity did not remain constant during the course of the experiments but was reduced.

Activity of nitrifying bacteria grown in nutrient solutions of different acid concentrations.—Preliminary experiments showed

that a satisfactory medium was obtained by simply using water and ammonium sulphate. Erlenmeyer flasks (300-cc capacity) were used as containers. Distilled water (100 cc) was poured into each flask and 0.1 gram of ammonium sulphate was added. The culture solution was neutralized with dilute sodium hydroxide and the desired acidity established with dilute sulphuric acid. The reactions were made to range from pH 2.0 to pH 8.8. The alkaline reaction (pH 8.8) was obtained by the addition of calcium carbonate. Duplicate cultures were made for each reaction. One gram of fresh garden soil of sandy type and having only traces of carbonates was added to each culture solution. The cultures were incubated for twenty-eight days at ordinary room temperature (25° to 30° C.), and the concentration in each flask was maintained by adding distilled water from time to time. The cultures were then analyzed for nitrates and acidity. The pH determinations were made by the electrometric method using the antimony electrode. The results are presented in Table 2.

TABLE 2.—*Activity of nitrifying bacteria grown in nutrient solutions of different acid concentrations.*

Series.	pH value.	Nitrate nitrogen. ^a	Added nitrogen. nitrified.	Series.	pH value.	Nitrate nitrogen. ^a	Added nitrogen. nitrified.
		mg.	Per cent.			mg.	Per cent.
12.....	2.0	Nil.	Nil.	29.....	3.8	Nil.	Nil.
13.....	2.0	Nil.	Nil.	30.....	4.4	Nil.	Nil.
14.....	2.6	Nil.	Nil.	31.....	4.4	Nil.	Nil.
15.....	2.6	Nil.	Nil.	32.....	4.8	Nil.	Nil.
16.....	2.9	Nil.	Nil.	33.....	4.8	Nil.	Nil.
17.....	2.9	Nil.	Nil.	34.....	5.2	Nil.	Nil.
20.....	3.2	Nil.	Nil.	35.....	5.2	Nil.	Nil.
21.....	3.2	Nil.	Nil.	36.....	6.6	Trace.	Trace.
26.....	3.6	Nil.	Nil.	37.....	6.6	Trace.	Trace.
27.....	3.6	Nil.	Nil.	38.....	7.0	0.40	1.90
28.....	3.8	Nil.	Nil.	39.....	8.8	4.44	21.14

^a After addition of 0.1 g of ammonium sulphate.

The data (Table 2) show that only a slight amount of nitrate was obtained in cultures that had an acid reaction of pH 6.6 and no nitrates were found in cultures of greater acidity. Cultures having reactions ranging from neutral to alkaline produced a much larger amount of nitrates. The highest nitrate production occurred in cultures in which calcium carbonate was added. The reaction of these cultures was pH 8.8, and the nitrate nitrogen

with this reaction was 21.14 per cent of the added nitrogen. These results indicated that nitrification processes proceeded very slowly in a medium having a slight acid reaction.

The influence of carbonates on the activity of nitrifying bacteria in acid soils.—These experiments aimed to ascertain the effect of carbonates on the activity of the nitrifying bacteria in acid soils.

The soil employed was a brown silt loam with a very low lime requirement—0.005 per cent calcium carbonate equivalent per hectare as determined by Hopkins's method for soil acidity. These experiments were made in series, each of which consisted of thirteen separate cultures of 100 grams (computed on a water-free basis). Each soil culture was placed in an Erlenmeyer flask of 300-cc capacity. Each series represented a certain acid concentration ranging from 0.005 to 5.0 per cent. The acidity was established by the addition of sulphuric acid to the soil. After the acid was added the soil was stirred thoroughly to obtain a uniform mixture. The acidified soil cultures were set aside overnight, after which 0.2 gram of ammonium sulphate was added to the contents of each flask. All cultures were adjusted to contain 60 per cent moisture and were incubated for twenty-eight days at ordinary room temperature. The moisture content was kept constant during the period of incubation. The cultures were then analyzed as follows: Ten for nitrate nitrogen, two for acidity, and the remainder for carbonate carbon by Parr's method. (19)

As shown by the results (Table 3) cultures that had from 1 to 5 per cent of acid contained no carbonates and also had no nitrates. Cultures with acid concentrations ranging from 0.9 to 0.005 per cent contained both carbonates and nitrates, but the amounts were inversely proportional to the acid content. After twenty-eight days' incubation the cultures that had carbonates gave nitrate nitrogen upon analysis. The amount of nitrate for each culture was in direct proportion to the carbonate content of the soil. The experiments show that, within certain limits, both carbonates and acid can exist in the soil at the same time and that the amount of carbonate remaining depends upon the amount of acid present. Furthermore, whenever a quantity of carbonate is present nitrification processes can take place until the last trace of carbonate is removed.

TABLE 3.—*Influence of carbonates on the activity of nitrifying bacteria in acid soils.*

Series.	Acid (in terms of H_2SO_4).	Carbonate carbon in the soil.	Nitrate nitrogen per 100 g of soil.		Added nitrogen nitrified.
			Control soil.	Soil treated with 0.2 g ammonium sulphate.	
	<i>Per cent.</i>	<i>Per cent.</i>	<i>mg.</i>	<i>mg.</i>	<i>Per cent.</i>
40	5.00	Nil.	Nil.	Nil.	Nil.
41	4.00	Nil.	Nil.	Nil.	Nil.
42	3.00	Nil.	Nil.	Nil.	Nil.
43	2.00	Nil.	Nil.	Nil.	Nil.
44	1.00	Nil.	Nil.	Nil.	Nil.
45	0.90	0.0045	Trace.	Trace.	Trace.
46	0.80	0.0036	0.0160	0.121	0.25
47	0.70	0.0073	0.0224	0.182	0.38
48	0.60	0.0127	0.0250	0.227	0.48
49	0.50	0.0128	0.0320	0.284	0.60
50	0.40	0.0143	0.0365	0.331	0.70
51	0.30	0.0140	0.0360	0.348	0.74
52	0.20	0.0127	0.0410	2.309	5.40
53	0.10	0.0146	0.0540	2.343	5.45
54	0.09	0.0163	0.1366	9.301	21.32
55	0.08	0.0164	0.2044	13.930	32.63
56	0.07	0.0164	0.2078	13.106	30.71
57	0.06	0.0173	0.2864	18.149	42.53
58	0.05	0.0173	0.6254	20.105	46.34
59	0.04	0.0173	0.2450	14.105	33.00
60	0.03	0.0173	0.3230	18.740	43.85
61	0.005	0.0192	0.7984	21.055	48.23

The soil is a heterogenous mixture of inorganic and organic constituents. An average sample may have an acid reaction, although some particles may contain carbonates not yet acted upon by the acid present. It would seem that the nitrification process, as observed in acid soils, actually takes place in those soil particles containing a considerable amount of carbonates. Perhaps this will explain the apparent inconsistency of nitrification in acid soils.

SUMMARY

The results obtained in this investigation confirmed the findings of others that nitrification may occur in acid soils (Table 1). It was found that an acid concentration of 0.5 to 1.0 per

cent in the soil inhibits the activity of nitrifying bacteria. Nitrate production was highest in cultures containing the lowest acid concentration. In a culture containing 0.005 per cent acid, over 90 per cent of the nitrogen added was converted into nitrate nitrogen.

When nitrification tests were conducted in a nutrient solution, nitrate production was not obtained in all cultures having an acid reaction. Again, in cultures of neutral reaction only a very slight degree of nitrification was observed. Normal production of nitrate occurred when calcium carbonate was added to neutral cultures.

It was found that both acid and carbonate radicals can exist at the same time in an acid soil and that, under these conditions, a certain degree of nitrification can take place depending upon the amount of carbonates present.

Summarizing the results of these experiments it would seem that nitrification processes can take place in an acid soil if carbonates are present. The occurrence of nitrification in acid soils would appear to be due to the presence of carbonates.

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PHILIPPINE GINGER IN RELATION TO THE UNITED STATES FOOD AND DRUGS ACT

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TWO PLATES

A considerable amount of ginger root is imported into the United States. In 1931 the imports amounted to 5,059,184 pounds valued at 563,228 pesos.¹ The Philippine Bureau of Commerce and Industry has been receiving letters² from prominent dealers inquiring as to the quality of ginger grown in the Philippines. Very likely the production of Philippine ginger could be developed into a profitable industry provided a satisfactory product can be produced.

This investigation was undertaken primarily to ascertain if Philippine ginger conforms to the requirement for ginger imported into the United States.

From early times ginger (*Zingiber officinale* Roscoe) has been known for its medicinal properties as a carminative and stimulant. There are many pharmaceutical preparations containing ginger and these are official in the various pharmacopœias. Because of its aromatic and pleasantly pungent taste it is used extensively as a spice and also as a flavoring agent in the manufacture of soft drinks. The young and tender ginger rhizomes are made into confectionery and condiments (preserved ginger).

Ginger is widely cultivated in small lots throughout the Philippines, but it has never been planted on a large scale. It has been estimated that the yield of ginger roots under Philippine conditions is about 1,000 to 1,700 kilos per hectare.³ There are two varieties grown locally (Plates 1 and 2). One is known as the Hawaiian and the other as the native (Philippine) variety. The Hawaiian variety has a larger rhizome than the

¹ Foreign Commerce and Navigation of the United States (1931) 421.

² Rivera, P., Comm. and Ind. Journ. (Philippines) 6 (1930) 9.

³ Philippine Bureau of Agriculture Circular No. 142 (1924).

native variety but, when fresh, it is less pungent. There are, however, grades between these two varieties.

Investigations of Philippine ginger have been made by Bacon,⁴ Adriano and Tavanlar,⁵ and Valenzuela.⁶

Bacon found that the light yellow oil obtained by distillation from two lots of Philippine ginger roots differs quite markedly in its properties from that distilled from Jamaica or African varieties. The oil from Philippine ginger is readily soluble in 90 per cent alcohol and has a negative rotation. In this respect it resembles some Japanese ginger oils examined by Schimmel and Company. Bacon also determined the physical constants of the oil and quoted Zimmermann⁷ concerning the cultivation and preparation of ginger.

In their report on the calcium oxide content of Philippine foods Adriano and Tavanlar stated that the ash of Philippine ginger contains 1.27 per cent calcium oxide corresponding to 0.05 per cent based on the dried sample.

Valenzuela made histological and phytochemical studies of Philippine ginger and concluded that the local product has the general characteristic properties of foreign commercial varieties. In his investigation considerable attention was directed to the chemical composition and properties of the volatile and fatty oils found in Philippine ginger. He also studied the morphological characteristics of the different tissues comprising the ginger rhizome and the distribution of the pungent principles in these tissues.

EXPERIMENTAL PROCEDURE

Fresh rhizomes from ginger grown locally were used for our experiments. Twelve samples were purchased in the Manila markets during January, February, and March, 1935. Two other samples, that were kindly presented to us by Dr. N. B. Mendiola, were obtained from plants cultivated at the experiment station of the College of Agriculture, University of the Philippines.

The ginger roots were washed thoroughly to remove adhering particles of soil and other foreign matter. The clean rhizomes were cut into small pieces that were sun-dried and then ground into a fine powder.

⁴ Philip. Journ. Sci. § A 5 (1910) 259.

⁵ Philip. Agr. 14 (1925) 347.

⁶ Journ. Am. Pharm. Assoc. 15 (1926) Nos. 8 and 9.

⁷ Communications from the Biologico-Agricultural Institute, Amari, Reprint from Usumbara Post (1904) No. 28.

In analyzing the ginger samples we followed the usual official methods for spices and other condiments.⁸

In Table 1 are given data for the requirements of ginger imported into the United States.

TABLE 1.—Standard requirements for dried ginger roots according to the United States Food and Drugs Act.*

Constituent.	Per cent.
Starch	42 or more.
Crude fiber	8 or less.
Lime (CaO)	1 or less.
Cold-water extract	12 or more.
Total ash	7 or less.
Ash insoluble in hydrochloric acid	2 or less.
Ash soluble in cold water	2 or more.

* Dunn's Food and Drug Laws 1 (1927-1928) 132.

The results of analyzing some samples of Philippine ginger are recorded in Table 2. As shown by the data these samples conformed to the requirements for ginger imported into the United States (Table 1).

TABLE 2.—Analyses of Philippine ginger samples that conform to the United States standard.

Sample No.	Variety.	Moisture.	Ether extract.	Alcoholic extract.	Cold-water extract.	Crude fiber.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
4	Native.....	12.81	7.99	9.30	15.61	5.00
5	Hawaiian.....	7.81	8.91	8.84	21.06	5.37
6	Intermediate*.....	6.76	9.05	7.48	24.80	3.63
8	Hawaiian.....	9.11	10.66	11.24	13.63	7.26
12	Native.....	7.81	9.61	9.63	16.49	6.04

Sample No.	Variety.	Starch.	Calcium oxide.	Ash.		
				Total.	Soluble in water.	Insoluble in HCl.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
4	Native.....	43.22	0.32	6.17	5.55	1.04
5	Hawaiian.....	47.11	0.32	6.36	5.99	0.51
6	Intermediate*.....	49.49	0.34	6.56	5.49	0.61
8	Hawaiian.....	42.81	0.32	5.81	5.79	0.30
12	Native.....	48.86	0.17	6.23	4.89	0.10

* Intermediate between Hawaiian and native varieties.

⁸ Methods of Analysis of the Association of Official Agricultural Chemists, 3d ed. (1930) 349.

Other samples of ginger that we analyzed (Table 3) did not exactly conform to the United States standard. Some had less than the required amount of starch (42 per cent), while others contained more than the maximum quantity allowed for ash (7 per cent). As far as other constituents are concerned these samples were satisfactory for export.

TABLE 3.—*Analyses of Philippine ginger samples that do not conform exactly to the United States standard.*

Sample No.	Variety.	Moisture.	Ether extract.	Alcoholic extract.	Cold-water extract.	Crude fiber.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
1	Hawaiian.....	7.67	8.69	12.60	17.96	4.34
2	Do.....	7.04	6.77	9.81	16.70	4.77
3	Intermediate.....	8.10	10.13	10.27	18.56	4.93
4A	Native.....	8.34	7.60	9.71	17.70	6.23
7	Do.....	5.86	7.47	6.30	22.62	4.64
9	Hawaiian ^a	9.26	9.32	9.99	18.11	6.31
10	Intermediate ^a	11.18	8.07	8.58	18.24	7.60
11	Native ^a	12.87	9.76	7.08	19.35	6.91
13	Hawaiian.....	6.49	8.54	11.39	18.20	7.20

Sample No.	Variety.	Starch.	Calcium oxide.	Ash.		
				Total.	Soluble in water.	Insoluble in HCl.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
1	Hawaiian.....	39.21	0.26	7.64	6.29	0.16
2	Do.....	41.19	0.31	9.82	9.02	0.60
3	Intermediate.....	40.93	0.33	9.59	8.49	1.13
4A	Native.....	41.15	0.37	8.44	7.21	1.23
7	Do.....	50.93	0.35	8.23	7.18	1.09
9	Hawaiian ^a	42.11	0.12	8.81	7.94	0.58
10	Intermediate ^a	44.26	0.34	8.41	5.26	0.52
11	Native ^a	42.11	0.35	8.78	7.48	0.26
13	Hawaiian.....	48.06	0.32	9.56	8.38	0.12

^a Analyzed by Miss Luz Cosme, Bureau of Science.

It would seem that ginger is rather variable in composition. Samples of foreign ginger, like the local product, show decided differences in analysis. The data (Table 4) indicate that the local ginger is somewhat superior to foreign ginger in that it has a larger amount of extractives and water-soluble ash.

TABLE 4.—Comparative average analyses of Philippine and foreign ginger.

Constituent.	Ginger.					
	Philippine.			Foreign. ^a		
	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Moisture.....	12.87	5.86	8.65	11.72	3.71	10.44
Alcohol extract.....	12.60	6.30	9.40	6.58	3.63	5.18
Ether extract.....	10.56	6.77	8.74	8.51	3.78	6.07
Cold-water extract.....	24.80	13.63	18.50	17.55	10.92	13.42
Crude fiber.....	7.60	3.63	5.73	5.50	2.37	3.91
Starch.....	50.93	39.21	44.24	60.31	49.05	54.53
Calcium oxide.....	0.37	0.26	0.30	3.53	0.20	0.80
Ash:						
Total.....	9.82	5.81	7.88	9.35	3.61	5.27
Soluble in water.....	9.02	4.89	6.78	4.09	2.29	2.71
Insoluble in HCl.....	1.23	0.10	0.59	2.29	0.02	0.44

^a Leach, A. E., and A. L. Winton, Food Inspection and Analysis (1920) 463.

It is known that the chemical composition of plants is affected by the environmental conditions under which the plants are grown. It is, therefore, not surprising to find that some samples of Philippine ginger fall somewhat below the standard required by the United States Food and Drugs Act. Careful selection of root stock and proper cultivation would very likely yield a grade of ginger entirely satisfactory for export.

SUMMARY

Samples of Philippine ginger roots were analyzed to ascertain if this local product conforms to the requirements for ginger imported into the United States.

Some samples were found to be satisfactory for export, while others did not exactly meet the standard requirements for starch and total ash.

Careful selection of root stock and proper cultivation would very likely yield a grade of ginger entirely satisfactory for export purposes.

ILLUSTRATIONS

PLATE 1

Representative samples of fresh rhizomes of ginger grown in the Philippines and purchased in Manila markets.

- Sample 1. Hawaiian variety.
- 2. Hawaiian variety.
- 3. Intermediate between Hawaiian and native varieties.
- 4. Native variety.
- 4A. Native variety.
- 5. Hawaiian variety.
- 6. Intermediate between Hawaiian and native varieties.
- 7. Native variety.

PLATE 2

Samples of the fresh rhizomes of ginger grown at the experimental station, College of Agriculture, University of the Philippines, Los Baños, Laguna.

- Sample 12. Native variety.
- 13. Hawaiian variety.



PLATE 1.



PLATE 2.

DIATOMS FROM CALCUTTA, INDIA

By B. W. SKVORTZOW

Of Harbin, Manchoukuo

ONE PLATE

Through the kindness of Prof. Dr. S. R. Bose, of the Carmichael Medical College, Calcutta, India, I have been enabled to examine two samples of diatoms, collected in Calcutta. Sample 1 is from mosses and algæ from tree bark, dated February 15, 1926; sample 2 is mud from a channel.

The first list of Calcutta diatoms is given by C. G. Ehrenberg.¹ He examined the earth from Calcutta Botanical Garden and the mud from a lake of Tank-Square, collected by Dr. Philippi in 1845.

Nearly all diatoms listed by Ehrenberg are of cosmopolitan nature, as follows:

<i>Amphora gracilis.</i>	<i>Gallionella granulata.</i>
<i>Amphora libyca.</i>	<i>Gallionella laevis.</i>
<i>Cocconeis placentula.</i>	<i>Gallionella procera.</i>
<i>Cocconema lupula.</i>	<i>Gallionella tenerima.</i>
<i>Coscinodiscus argus.</i>	<i>Gomphonema clavatum.</i>
<i>Coscinodiscus centralis.</i>	<i>Gomphonema gracile.</i>
<i>Coscinodiscus heteroporus.</i>	<i>Pinnularia borealis.</i>
<i>Coscinodiscus subtilis.</i>	<i>Pinnularia viridula.</i>
<i>Fragilaria acuta.</i>	<i>Surirella bifrons.</i>
<i>Fragilaria pinnata.</i>	<i>Synedra curvata.</i>
<i>Gallionella aurichalcea.</i>	<i>Synedra entomon.</i>
<i>Gallionella distans.</i>	<i>Synedra ulna.</i>

Professor Bose's collections are of great interest. The material is sufficiently rich in diatoms, especially small forms, half of which are new. The sample from mosses, No. 1, is rich in aerophytic species, especially—

<i>Melosira roeseana</i> var. <i>indica.</i>	<i>Navicula medica.</i>
<i>Stauroneis calcuttensis.</i>	<i>Pinnularia calcutta.</i>
<i>Navicula microcephala.</i>	<i>Amphora normani.</i>
<i>Navicula insociabilis.</i>	<i>Hantzschia amphioxys.</i>
<i>Navicula seminulum.</i>	<i>Nitzschia communis.</i>
<i>Navicula pseudoseminulum.</i>	<i>Nitzschia frustulum.</i>
<i>Navicula boseana.</i>	<i>Nitzschia microcephala.</i>

¹ Mikrogeologie 124-127.

The sample from a channel, No. 2, contains fresh- and brackish-water forms, especially—

<i>Diploneis puella.</i>	<i>Rhopalodia gibberula.</i>
<i>Navicula cuspidata.</i>	<i>Nitzschia obtusa.</i>
<i>Navicula cryptocephala.</i>	<i>Nitzschia thermalis.</i>
<i>Navicula pygmaea</i> var. <i>indica.</i>	<i>Nitzschia commutata.</i>
<i>Navicula capitellata.</i>	<i>Nitzschia palea.</i>
<i>Navicula budda.</i>	<i>Nitzschia vermicula.</i>
<i>Navicula calcuttensis.</i>	<i>Nitzschia fonticola.</i>
<i>Amphora normani.</i>	<i>Nitzschia amphibia.</i>
<i>Amphora veneta.</i>	<i>Nitzschia frustulum.</i>
<i>Amphora coffeaeformis.</i>	<i>Nitzschia filiformis.</i>

Two samples yielded fifty-six forms, a list of which is given below. The diatoms were examined with apochromat 2 mm of E. Leitz and compens. oculars No. 6, 8, and 12. The note is illustrated with drawings (Plate 1) by the author, and the number after each species, in the text, corresponds to the locality from which it was obtained.

MELOSIRA ROESEANA Rabh. var. **INDICA** var. nov. Plate 1, fig. 1.

Valve circular with large marginal costæ, passing to the puncta zone. Center hyaline with one or two large puncta. Diameter, 0.035 mm. Costæ 14 in 0.01 mm. Not common. Sample 1.

ACHNANTHES EXIGUA Grun. Plate 1, fig. 2.

Achnanthes exigua Grun., F. HUSTEDT, Bacillar. (1930) 201, fig. 286.

Valve broad-lanceolate with truncate ends. Length, 0.012 mm; breadth, 0.0042 mm. Striæ 24 in 0.01 mm. Central areas a broad stauros. A fresh-water species. Not common. Sample 2.

ACHNANTHES EXIGUA Grun. var. **INDICA** var. nov. Plate 1, fig. 3.

Valve slightly siliceous, small and short. Length, 0.006 mm; breadth, 0.0034. Striæ 24 in 0.01 mm. Common. Sample 1.

DIPLONEIS PUELLA (Schumann) Cleve. Plate 1, fig. 4.

Diploneis puella (Schumann) CLEVE, F. HUSTEDT, Bacillar. (1930) 250, fig. 394.

Valve elliptical-lanceolate with broad ends. Length, 0.007 mm; breadth 0.0035. Axial areas lanceolate. Striæ 15 in 0.01 mm, radiate. A brackish-water diatom. Not common. Sample 2.

STAURONEIS CALCUTTENSIS sp. nov. Plate 1, figs. 5 and 6.

Valve linear-lanceolate with parallel margins, narrowed towards the ends. Length, 0.015 to 0.022 mm; breadth, 0.0034 to 0.004. Ends subrostrate, rounded. The truncate part of the ends divided by a band. Median line straight, axial areas narrow and indistinct. Central areas a broad stauros, widened and truncate outwards. Striæ 18 to 24 in 0.01 mm, slightly radiate, shortened in the middle part. This species is akin to *Stauroneis parvula* Grun. Common. Sample 1.

STAURONEIS PARVULA Grun. var. **LANCEOLATA** var. nov. Plate 1, fig. 7.

Valve strongly linear with narrowed ends. Length, 0.018 mm; breadth, 0.0034. Striæ 24 in 0.01 mm, forming in the middle part a broad stauros widened to the margins.

NAVICULA CUSPIDATA Kutz. var. **AMBIGUA** (Ehr.) Cleve. Plate 1, fig. 8.

Navicula cuspidata Kutz. var. *ambigua* (Ehr.) Cleve, F. HUSTEDT, Bacillar. (1930) 268, fig. 434.

Valve lanceolate with rostrate-capitate ends. Length, 0.074 mm; breadth, 0.018. A fresh-water species. Common. Sample 2.

NAVICULA VIRIDULA Kutz. **CALCUTTENSIS** var. nov. Plate 1, fig. 9.

Valve linear-elliptical, narrowed towards the ends. Ends broad, rounded. Length, 0.024 mm; breadth, 0.007. Striæ divergent in the middle, convergent at the ends, 12 to 14 in 0.01 mm. Axial area very narrow, central areas small, slightly transversely dilated. Not common. Sample 2.

NAVICULA MENISCULUS Schumann. Plate 1, fig. 10.

Navicula menisculus Schumann, VAN HEURCK, Synopsis (1880-81) pl. 8, figs. 21, 22.

Valve broad-lanceolate with truncate rounded ends. Length, 0.018 mm; breadth, 0.006. Striæ radiate, 15 in 0.01 mm. Not common. Sample 2.

NAVICULA CRYPTOCEPHALA Kutz. Plate 1, fig. 11.

Navicula cryptocephala Kutz., F. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate with subacuminate rounded ends. Length, 0.022 to 0.028 mm; breadth, 0.005 to 0.0068. Striæ radiate, 15 to 18 in 0.01 mm. Common. Sample 2.

NAVICULA CRYPTOCEPHALA Kutz. var. VENETA Kutz. Plate 1, fig. 12.

Navicula cryptocephala Kutz. var. *veneta* Kutz., VAN HEURCK, Synopsis (1880-81) pl. 8, figs. 3, 4.

Valve lanceolate, narrowed towards the ends. Length, 0.017 to 0.018 mm; breadth, 0.005 to 0.0068. A brackish-water diatom. Common. Sample 2.

NAVICULA MICROCEPHALA Grun. Plate 1, fig. 13.

Navicula microcephala Grun., F. HUSTEDT, Bacillar. (1930) 289, fig. 491.

Valve slightly siliceous, lanceolate, with obtuse ends. Length, 0.01 mm; breadth, 0.0025. Areas indistinct. Striæ very fine, about 30 in 0.01 mm. A fresh-water diatom known from all parts of the world. Common. Sample 1.

NAVICULA PYGMAEA Kutz. var. INDICA var. nov. Plate 1, fig. 14.

Valve elliptical with obtuse ends. Lateral areas convergent and constricted in the middle. Length, 0.02 to 0.024 mm; breadth, 0.0085 to 0.01. Striæ fine, about 24 in 0.01 mm. As in the type, but with broader ends. *Navicula pygmaea* is known in brackish waters of Europe, northern Siberia, and South America. Common. Sample 2.

NAVICULA INSOCIABILIS Krasske. Plate 1, fig. 15.

Navicula insociabilis KRASSKE, Beiträge zur Ken. der Diatom. der Alpen (1932) 114, pl. fig. 17.

Valve lanceolate, narrowed towards the ends, truncate. Length, 0.015 to 0.017 mm; breadth, 0.006. Axial area very narrow. Central area slightly transversely dilated. Striæ slightly radiate, 21 in 0.01 mm. Known from Europe in mosses and on wet rocks. Common on the bark of trees in Calcutta. Sample 1.

NAVICULA INSOCIABILIS Krasske var. LANCEOLATA var. nov. Plate 1, fig. 16.

Valve lanceolate, more narrowed towards the ends. Length, 0.017 to 0.019 mm; breadth, 0.005 to 0.006. Striæ 18 in 0.01 mm. This variety differs from the type by its more elongate valves. Very common. Sample 1.

NAVICULA SEMINULUM Grun. Plate 1, fig. 17.

Navicula seminulum Grun., VAN HEURCK, Synopsis (1880-81) pl. 14, fig. 10.

Valve lanceolate with truncate ends. Length, 0.017 mm; breadth, 0.005. Striæ 20 in 0.01 mm, radiate, not crossed by

longitudinal bands. This species resembles *Navicula pseudoseminulum* sp. nov. Common in mosses from Calcutta. Sample 1.

NAVICULA PSEUDOSEMINULUM sp. nov. Plate 1, fig. 18.

Valve lanceolate with truncate ends. Length, 0.017 to 0.03 mm; breadth, 0.005 to 0.0068. Axial areas very narrow. Central areas a broad stauros, widened and truncate outwards. Striæ slightly radiate, 20 to 24 in 0.01 mm, crossed by three to five broad, blank, longitudinal, undulating bands. Striæ finely punctate. Not common. Sample 1.

NAVICULA PSEUDOSEMINULUM var. *CURTA* var. nov. Plate 1, fig. 19.

A form with small valves. Length, 0.008 to 0.01 mm; breadth, 0.005. Striæ 24 in 0.01 mm. Sample 1.

NAVICULA EXIGUA (Gregory) O. Muller var. *CALCUTTENSIS* var. nov. Plate 1, fig. 20.

Valve lanceolate with capitate ends. Length, 0.018 mm; breadth, 0.005. Central areas a short fascia. Striæ radiate, 18 in 0.01 mm. Not common. Sample 1.

NAVICULA CAPITELLATA sp. nov. Plate 1, fig. 21.

Valve lanceolate, slightly gibbous in the middle with short capitate ends. Length, 0.016 mm; breadth, 0.0045. Median line straight, axial areas narrow, somewhat dilated in the middle. Striæ 15 to 18 in 0.01 mm, slightly radiate. This species resembles *Navicula bicapitellata* Hustedt. Not common. Sample 2.

NAVICULA BUDDA sp. nov. Plate 1, fig. 22.

Valve small, lanceolate with parallel margins, ends truncate. Length, 0.012 mm; breadth, 0.006. Median line filiform. Axial area very narrow, central area orbicular. Striæ 15 in 0.01 mm, radiate at the ends, more distant in the middle. Rare. Sample 2.

NAVICULA BOSEANA sp. nov. Plate 1, fig. 23.

Valve lanceolate with subrostrate rounded ends. Length, 0.01 to 0.015 mm; breadth, 0.0025 to 0.0034. Axial areas very narrow, median line straight. Striæ slightly radiate, in the middle bilaterally shortened. Central area widened and truncate outwards. This small species is connected with *Navicula minuta* Grun. Named in honor of S. R. Bose, professor of botany,

Carmichael Medical College, Calcutta, India. Common. Samples 1 and 2.

NAVICULA BOSEANA var. *BACILLUM* var. nov. Plate 1, fig. 24.

Valve linear, obtuse. Length, 0.021 mm; breadth, 0.0034. Striæ 15 to 16 in 0.01 mm. Differs from the type by its linear obtuse valve.

NAVICULA MEDICA sp. nov. Plate 1, fig. 25.

Valve broad-lanceolate with parallel margins and cuneate ends. Length, 0.013 to 0.015 mm; breadth, 0.004. Median line straight, axial areas very narrow. Central areas a broad stauros, widened and truncate outwards. Striæ 18 to 20 in 0.01 mm, slightly radiate. *Navicula medica* is an isolated species, akin to *Navicula boseana*.

NAVICULA CALCUTTENSIS sp. nov. Plate 1, fig. 26.

Valve lanceolate, narrowed toward the ends. Length, 0.02 mm; breadth, 0.004. Axial area very narrow; central area small. Median lines straight with approximate central pores. Striæ 15 in 0.01 mm, slightly radiate towards the ends. This species is connected with *Navicula falaisiensis* Grun. Common. Sample 2.

NAVICULA CALCUTTENSIS var. *GRACILIS* var. nov. Plate 1, fig. 27.

Valve lanceolate with obtuse ends. Length, 0.015 mm; breadth, 0.0028. Striæ 18 in 0.01 mm. Var. *gracilis* differs from the type by its smaller size and obtuse ends. Common. Sample 2.

PINNULARIA CALCUTTA sp. nov. Plate 1, fig. 28.

Valve linear, narrowed towards the ends. Ends strongly capitate. Length, 0.026 mm; breadth, 0.0034. Axial area narrow, somewhat dilated in the middle. Central area a broad transverse fascia. Striæ radiate, divergent in the middle, convergent at the ends, 18 in 0.01 mm. This species has some resemblance to *Pinnularia divergentissima* (Grun.) Cleve. Common. Samples 1 and 2.

PINNULARIA CALCUTTA var. *CURTA* var. nov. Plate 1, fig. 29.

Valve shorter. Length, 0.018 mm; breadth, 0.00034. Striæ 18 in 0.01 mm. Common. Sample 1.

AMPHORA NORMANI Rabh. Plate 1, fig. 30.

Amphora normani Rabh., VAN HEURCK, Synopsis (1880-81) pl. 1, fig. 12.

Valve narrowed towards the ends, capitate. Central area with a distinct broad fascia. Length, 0.014 to 0.017 mm; breadth, 0.003 to 0.0034. Very common. Known in fresh water. Samples 1 and 2.

AMPHORA NORMANI Rabh. var. **GIBBOSA** var. nov. Plate 1, fig. 31.

Valve gibbous, on the dorsal side with a broad fascia reaching the margin. Length, 0.017 mm; breadth, 0.005. Not common. Sample 1.

AMPHORA VENETA Kutz. var. **MINOR** Frenguelli. Plate 1, fig. 32.

Amphora veneta Kutz. var. *minor* FRENGUELLI, Diatom. d. los Arroyos del Durazno y las Brusquitas (1925) 148, pl. 1, figs. 3 and 4.

Valve small, undulated on the dorsal and straight on the ventral side. Length, 0.009 mm; breadth, 0.0038. Reported from South America. Rare. Sample 2.

AMPHORA VENETA Kutz. var. **INDICA** var. nov. Plate 1, fig. 33.

Valve gibbous with truncate ends. Length, 0.012 mm; breadth, 0.0034. Striæ in the middle 15 in 0.01 mm; at the ends 20 in 0.01 mm. This variety is nearly related to var. *gibbosa* Frenguelli.² A fresh- and brackish-water diatom. Common. Sample 2.

AMPHORA PERPUSILLA Grun. Plate 1, fig. 34.

Amphora perpusilla Grun., F. HUSTEDT, Bacillar. (1930) 343, fig. 627.

Valve very small, slightly siliceous. Length, 0.006 mm; breadth, 0.002. A fresh-water diatom. Rare. Sample 1.

AMPHORA COFFEAIFORMIS Agardh. Plate 1, figs. 35 and 36.

Amphora coffeaiformis Agardh., A SCHMIDT, Atlas Diatom. pl. 26, fig. 56.

Frustule lanceolate, gibbous in the middle. Length, 0.027 to 0.04 mm; breadth, 0.011 to 0.012. Median line slightly arcuate. Axial area narrow, somewhat dilated in the middle. Striæ slightly radiate, 10 dorsal striæ in 0.01 mm; 12 ventral striæ

² Diatomeas Fosiles Prebelgranense de Miramar (1926) 27, pl. 1, fig. 1.

in 0.01 mm. A brackish-water species. Rare. Samples 1 and 2.

GOMPHONEMA PARVULUM (Kutz.) Grun. Plate 1, figs. 38 and 39.

Gomphonema parvulum (Kutz.) Grun., F. HUSTEDT, Bacillar. (1930) 372, fig. 713a.

Valve lanceolate, with obtuse apex and base. Length, 0.018 to 0.022 mm; breadth, 0.005 to 0.006. Striæ slightly radiate, 15 to 16 in 0.01 mm, more distant in the middle than elsewhere. A fresh-water diatom. Rare. Sample 1.

GOMPHONITZSCHIA INDICA sp. nov. Plate 1, figs. 40 and 41.

Valve clavate, slightly gibbous in the middle, narrowed towards the apex and base. Length, 0.0085 to 0.011 mm; breadth, 0.002 to 0.0025. Costæ 12 to 15 in 0.01 mm. This species resembles *Gomphonitzschia ungeri*, but differs in having shorter valves and in the form of the ends. Not common. Sample 1.

RHOPALODIA GIBBERULA (Ehr.) O. Mull. var. **VAN HEURCKII** O. Mull. Plate 1, fig. 42.

Rhopalodia gibberula (Ehr.) O. Mull. var. *Van Heurckii* O. Mull., F. HUSTEDT, Bacillar. (1930) 391, fig. 744.

Valve gibbous in the middle of the dorsal side, straight on the ventral side, with reflexed apices. Costæ 3 to 5 in 0.01 mm. Striæ 16 in 0.01 mm. Length, 0.022 to 0.033 mm. A brackish-water species. Sample 1, rare.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. **XEROPHILA** Grun. Plate 1, fig. 43.

Hantzschia amphioxys (Ehr.) Grun. var. *xerophila* Grun., GRUNOW, Diatom, Franz Josefs Land 47.

Valve linear with truncate ends. Length, 0.03 to 0.035 mm; breadth, 0.005 to 0.006. Costæ 6 to 7 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. A fresh-water form. Common. Samples 1 and 2.

NITZSCHIA THERMALIS Kutz. Plate 1, figs. 44 and 45.

Nitzschia thermalis Kutz., F. HUSTEDT, Bacillar. (1930) 403, fig. 771.

Valve linear with truncate ends. Margins parallel. Length, 0.0034 to 0.073 mm; breadth, 0.0068 to 0.0076. Costæ 6 to 9 in 0.01 mm. Striæ 24 to 30 in 0.01 mm. A fresh-water diatom. Common. Sample 2.

NITZSCHIA THERMALIS Kutz. var. **CURTA** var. nov. Plate 1, fig. 46.

Valve short, linear, narrowed towards the ends. Margin parallel. Length, 0.019 mm; breadth, 0.009. Costæ 13 to 15 in 0.01 mm. Striæ 35 in 0.01 mm. Common. Sample 2.

NITZSCHIA COMMUTATA Grun. Plate 1, fig. 47.

Nitzschia commutata Grun., F. HUSTEDT, Bacillar. (1930) 405, fig. 774.

Valve linear, slightly constricted in the middle with truncate, rounded ends. Length, 0.06 mm; breadth, 0.0068. Costæ 7 in 0.01 mm. A species of slightly brackish water. Not common. Sample 2.

NITZSCHIA COMMUTATA Grun. var. CURTA var. nov. Plate 1, fig. 48.

Valve constricted with rostrate ends. Length, 0.02 mm; breadth, 0.005. Costæ 12 in 0.01 mm. Striæ 24 in 0.01 mm. This variety differs from the type in having shorter valves. Not common. Sample 2.

NITZSCHIA PALEA (Kutz.) W. Smith. Plate 1, fig. 49.

Nitzschia palea (Kutz.) W. Smith, A. SCHMIDT, Atlas Diatom. pl. 349, figs. 1 to 8.

Valve linear with rostrate ends. Length, 0.017 to 0.034 mm; breadth, 0.0025 to 0.0034. Keel puncta 10 to 15 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. A fresh-water species. Common. Samples 1 and 2.

NITZSCHIA PALEA (Kutz.) W. Smith var. TENUIROSTRIS Grun. Plate 1, fig. 50.

Nitzschia palea (Kutz.) W. Smith var. *tenuirostris* Grun., VAN HEURCK, Synopsis (1880-81) pl. 69, fig. 31.

Valve linear-lanceolate with attenuated ends. Length, 0.034 to 0.037 mm; breadth, 0.003 to 0.0038. Keel puncta 9 to 11 in 0.01 mm. Striæ 35 in 0.01 mm. Common. Samples 1 and 2.

NITZSCHIA VERMICA sp. nov. Plate 1, figs. 51 to 53.

Valve linear, vermiform or slightly sigmoid. Ends unilaterally rounded. Length, 0.012 to 0.018 mm; breadth, 0.002 to 0.0028. Keel puncta 12 in 15 mm. Striæ 24 in 0.01 mm. A species related to *Nitzschia frustulum* (Kutz.) Grun. Common. Samples 1 and 2.

NITZSCHIA FONTICOLA Grun. Plate 1, figs. 54 and 55.

Nitzschia fonticola Grun., A. SCHMIDT, Atlas Diatom. pl. 348, figs. 63-65.

Valve broad-lanceolate with attenuated subacuminate ends. Length, 0.018 to 0.02 mm; breadth, 0.0035 to 0.0042. Costæ strong, 12 in 0.01 mm. Striæ 30 in 0.01 mm. A fresh-water species. Common. Sample 2.

NITZSCHIA FONTICOLA Grun var. CONSTRICTA var. nov. Plate 1, fig. 56.

Valve lanceolate, constricted on one side, slightly gibbous on the other. Length, 0.01 mm; breadth, 0.002. Keel puncta 12 in 0.02 mm. Striæ 24 in 0.01 mm. Common. Sample 2.

NITZSCHIA COMMUNIS Rabh. Plate 1, fig. 60.

Nitzschia communis Rabh., FR. HUSTEDT, Bacillar. (1930) 417, fig. 793.

Valve lanceolate with narrowed ends. Length, 0.018 to 0.035 mm; breadth, 0.003 to 0.0042. Keel puncta 9 to 15 in 0.01 mm. Striæ 35 in 0.01 mm. A blackish-water diatom. Common. Samples 1 and 2.

NITZSCHIA AMPHIBIA Grun. Plate 1, fig. 57.

Nitzschia amphibia Grun., F. HUSTEDT, Bacillar. (1930) 414, fig. 793.

Valve lanceolate with keel puncta extended into short costæ. Costæ 3.4 to 4.2 in 0.01 mm. Puncta coarse, 15 in 0.01 mm. Length, 0.02 to 0.2 mm; breadth, 0.0034 to 0.0042. A fresh-water diatom. Not common. Sample 2.

NITZSCHIA AMPHIBIA Grun. var. ACUTIUSCULA Grun. Plate 1, fig. 58.

Nitzschia amphibia Grun. var. *acutiuscula* Grun., A. SCHMIDT, Atlas Diatom. pl. 348, figs. 42-44.

Differs from the type by more-lanceolate valves. Length, 0.02 mm; breadth, 0.0042. Costæ 6 to 7 in 0.01 mm. Striæ 14 in 0.01 mm. Not common. Sample 2.

NITZSCHIA FRUSTULUM (Kutz.) Grun. var. PERMINUTA Grun. Plate 1, fig. 59.

Nitzschia frustulum (Kutz.) Grun. var. *perminuta* Grun., VAN HEURCK, Synopsis (1880-81) pl. 99, fig. 7.

Valve linear-lanceolate with obtuse ends. Length, 0.011 to 0.017 mm; breadth, 0.002 to 0.0025. Keel puncta 12 to 15 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. A brackish-water diatom. Common. Samples 1 and 2.

NITZSCHIA FRUSTULUM (Kutz.) Grun. var. PERPUSILLA (Rabh.) Grun. Plate 1, figs. 57 and 61.

Nitzschia frustulum (Kutz.) Grun. var. *perpusilla* (Rabh.) Grun., VAN HEURCK, Synopsis (1880-81) pl. 98, figs. 25 and 26; pl. 99, fig. 6.

Valve lanceolate. Length, 0.0085 to 0.012 mm; breadth, 0.002 to 0.0025. Keel puncta 12 to 15 in 0.01 mm. Striæ 24 in 0.01 mm. Common. Samples 1 and 2.

NITZSCHIA FRUSTULUM (Kutz.) Grun. var. INDICA var. nov. Plate 1, fig. 62 and 63.

Valve very short. Length, 0.005 to 0.0085 mm; breadth, 0.002 to 0.0025. Keel puncta 18 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. Common. Samples 1 and 2.

NITZSCHIA MICROCEPHALA Grun. Plate 1, fig. 64.

Nitzschia microcephala Grun., F. HUSTEDT, Bacillar. (1930) 414, fig. 791.

Small valve with rostrate ends. Length, 0.011 to 0.012 mm; breadth, 0.0025 to 0.0037. Keel puncta 11 to 15 in 0.01 mm. Striæ 35 in 0.01 mm. A fresh-water species. Common. Samples 1 and 2.

NITZSCHIA FILIFORMIS (W. Smith) Hustedt. Plate 1, fig. 65.

Nitzschia filiformis (W. Smith) Hustedt, F. HUSTEDT, Bacillar. (1930) 422, fig. 818.

Valve linear, curved. Length, 0.042 mm; breadth, 0.0034. Costæ 10 to 12 in 0.01 mm. Striæ 35 in 0.01 mm. A brackish-water diatom. Rare. Sample 2.

NITZSCHIA OBTUSA W. Smith var. SCALPELLIFORMIS Grun. Plate 1, figs. 66 and 67.

Nitzschia obtusa W. Smith var. *scalpelliformis* Grun., VAN HEURCK, Synopsis (1880-81) pl. 67, fig. 2.

Valve slightly sigmoid. Margins parallel. Length, 0.064 to 0.093 mm; breadth, 0.007 to 0.0085. Costæ 8 to 9 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. A brackish-water diatom. Common. Sample 2.

ILLUSTRATION

PLATE 1

- FIG. 1. *Melosira Roeseana* Rabh. var. *indica*. var. nov.
 2. *Achnanthes exigua* Grun.
 3. *Achnanthes exigua* Grun. var. *indica* var. nov.
 4. *Diploneis puella* (Schumann) Cleve.
 FIGS. 5 and 6. *Stauroneis calcuttensis* sp. nov.
 FIG. 7. *Stauroneis parvula* Grun. var. *lanceolata* var. nov.
 8. *Navicula cuspidata* Kutz. var. *ambigua* (Ehr.) Cleve.
 9. *Navicula viridula* Kutz. var. *calcuttensis* var. nov.
 10. *Navicula menisculus* Schumann.
 11. *Navicula cryptocephala* Kutz.
 12. *Navicula cryptocephala* Kutz. var. *veneta* Kutz.
 13. *Navicula microcephala* Grun.
 14. *Navicula pygmaea* Kutz. var. *indica* var. nov.
 15. *Navicula insociabilis* Krasske.
 16. *Navicula insociabilis* Krasske var. *lanceolata* var. nov.
 17. *Navicula seminulum* Grun.
 18. *Navicula pseudoseminulum* sp. nov.
 19. *Navicula pseudoseminulum* var. *curta* var. nov.
 20. *Navicula exigua* (Gregory) O. Mull. var. *calcuttensis* var. nov.
 21. *Navicula capitellata* sp. nov.
 22. *Navicula budda* sp. nov.
 23. *Navicula Boseana* sp. nov.
 24. *Navicula Boseana* var. *bacillum* var. nov.
 25. *Navicula medica* sp. nov.
 26. *Navicula calcuttensis* sp. nov.
 27. *Navicula calcuttensis* var. *gracilis* var. nov.
 28. *Pinnularia calcutta* sp. nov.
 29. *Pinnularia calcutta* var. *curta* var. nov.
 30. *Amphora Normani* Rabh.
 31. *Amphora Normani* var. *gibbosa* var. nov.
 32. *Amphora veneta* Kutz. var. *minor* Frenguelli.
 33. *Amphora veneta* (Kutz.) var. *indica* var. nov.
 34. *Amphora perpusilla* Grun.
 FIGS. 35 and 36. *Amphora coffeaeformis* Agardh.
 FIG. 37. *Nitzschia frustulum* (Kutz.) Grun. var. *perminuta* Grun.
 FIGS. 38 and 39. *Gomphonema parvulum* (Kutz.) Grun.
 40 and 41. *Gomphonitzschia indica* sp. nov.
 FIG. 42. *Rhopalodia gibberula* (Ehr.) O. Mull. var. *Van Heurckii* O. Mull.
 43. *Hantzschia amphioxys* (Ehr.) Grun. var. *xerophila* Grun.
 FIGS. 44 and 45. *Nitzschia thermalis* Kutz.

- FIG. 46. *Nitzschia thermalis* Kutz. var. *curta* var. nov.
47. *Nitzschia commutata* Grun.
48. *Nitzschia commutata* Grun. var. *curta* var. nov.
49. *Nitzschia palea* (Kutz.) W. Smith.
50. *Nitzschia palea* (Kutz.) W. Smith var. *tenuirostris* Grun.
FIGS. 51 to 53. *Nitzschia vermicula* sp. nov.
54 and 55. *Nitzschia fonticola* Grun.
FIG. 56. *Nitzschia fonticola* Grun. var. *constricta* var. nov.
57. *Nitzschia amphibia* Grun.
58. *Nitzschia amphibia* Grun. var. *acutiuscula* Grun.
59. *Nitzschia frustulum* (Kutz.) Grun. var. *perminuta* Grun.
60. *Nitzschia communis* Rabh.
61. *Nitzschia frustulum* (Kutz.) Grun. var. *perpusilla* (Rabh.) Grun.
FIGS. 62 and 63. *Nitzschia frustulum* (Kutz.) Grun. var. *indica* var. nov.
FIG. 64. *Nitzschia microcephala* Grun.
65. *Nitzschia filiformis* (W. Smith) Hustedt.
FIGS. 66 and 67. *Nitzschia obtusa* W. Smith var. *scalpelliformis* Grun.

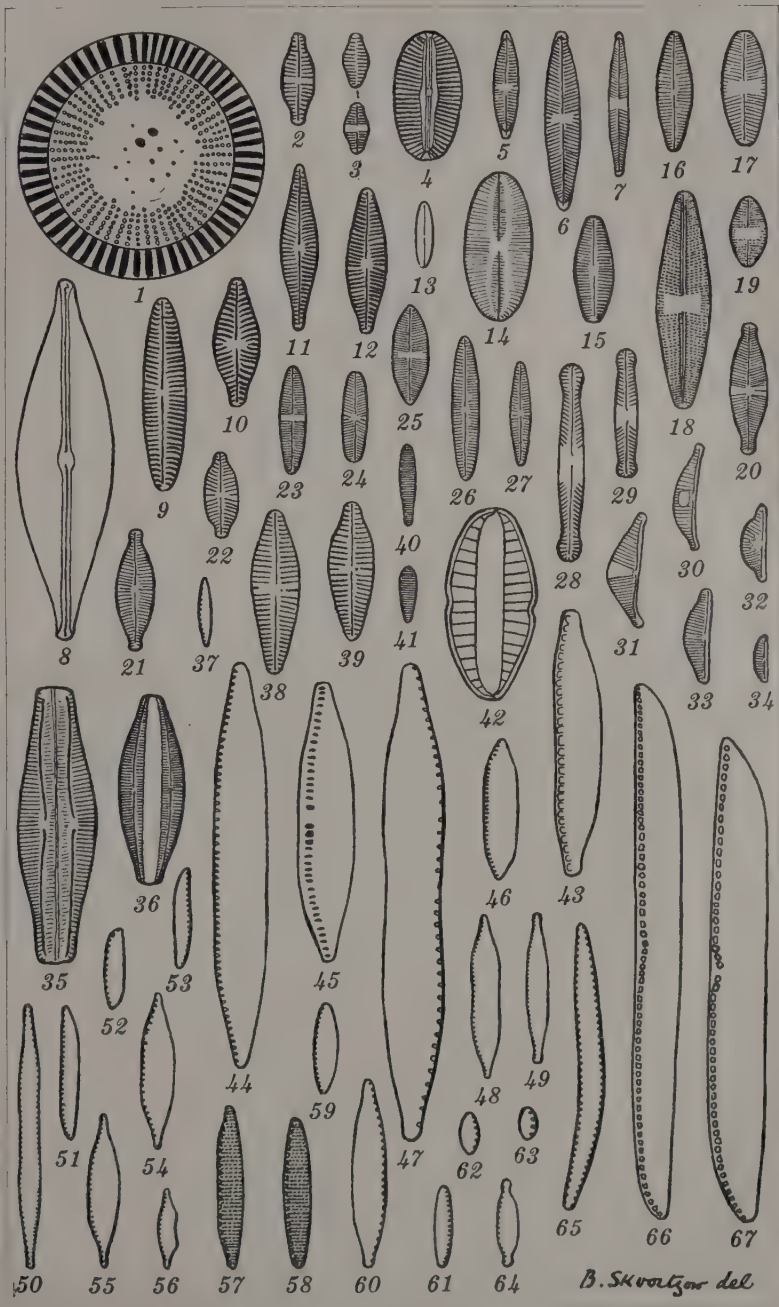


PLATE 1.

LIFE HISTORY AND ECONOMIC IMPORTANCE OF CABANIS'S WEAVER

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ONE PLATE

INTRODUCTION

Cabanis's weaver, *Munia cabanisi* Sharpe (Plate 1), is one of the Philippine weavers condemned by rice growers for the alleged damage they do to crops. The local names of this weaver, *bilit toleng* (Ilk.), *denas paking* (Pamp.), *mayang paking* (Tag.), all imply that the bird is deaf, obviously owing to the difficulty of driving it away from rice fields when the grain is in head. The species belongs to the subfamily Estrildinæ (= Viduinæ) of the family Ploceidæ. The description of the bird is given by Sharpe (1890), McGregor (1908), and others. The adult bird is relatively small, brownish raw umber above with light-colored shafts. The chin is Prout's brown, each feather being provided with lighter shaft lines. The upper tail coverts and rectrices are yellowish olive. The breast, abdomen, and other underparts are white, each feather with an exposed broad brown band surrounding the white median streak. The brown band is partly surrounded by a somewhat U-shaped white band, with a portion of its free arms covered by the overlapping feathers. The white band is continuous into a whitish buff fringe.

The sexes are similar. Measurements of twenty adult birds from various provinces in Luzon give the following averages: Length, 102 millimeters; wing, 50; culmen, 10.4; tail, 42; tarsus, 13.

DISTRIBUTION

Like its congener *Munia jagori*, *M. cabanisi* is an endemic species, but with a more-limited distribution. Sharpe (1890) says that it is confined to Luzon. Whitehead (1899) found the species to be very local. He met these birds feeding on grass seeds in Abra. McGregor (1909) cites Bourns and Worcester as having seen Cabanis's weaver in Panay once. The collection

of birds in the Bureau of Science, Manila, with samples from many parts of the Archipelago, shows that, except for a young female from Mindoro, *M. cabanisi* is found only in Luzon. It is abundant in northern and central Luzon, but appears to be rare in the southern part. Attempts to obtain specimens in Camarines Sur and Sorsogon Provinces in April, 1934, failed.

METHOD OF STUDY

Information about the general habits of the species was obtained through field observation, while the data on its food were secured by the examination of stomach contents.

The food of the young was determined qualitatively and only very superficially through the semitransparent skin of the throat.

The contents of the alimentary tract, including those of the stomach, of adult birds, were considered in the estimate. Collection of material was started in June, 1932, and observations on the behavior of the species were made as early as 1926. The latest records were made in April, 1934, and observations were still being made during the writing of this paper (March, 1935).

The birds used in this study were obtained from over one hundred collecting grounds in thirty-eight municipalities of ten provinces. Observations covered a larger area.

In the present study the percentage by bulk, based on the actual number of seeds recovered in the stomachs of the bird, was used. The percentage composition of the food was obtained by dividing the number of seeds of one weed item by the total number of weed seeds recovered and multiplied by 100. Likewise, the percentage of the seeds of weeds and of rice were obtained by dividing the number of seeds of weeds and of rice, respectively, by the total number of seeds obtained and multiplied by 100.

Weed seeds were determined by comparison with identified seeds.

As the weed seeds that enter into the food composition of Cabanis's weaver are numerous and as the seeds are oftentimes recovered in a more or less fragmentary condition, no high degree of precision is claimed in their specific determination. Care was taken, however, in segregating the rice from the weed seeds.

NIDIFICATION

The species is monogamous. Each pair was seen feeding together in the fields. They were also seen alternately feeding their young and bringing building materials to the nest.

Mating occurs on the perch. The act is generally preceded by an unusual activity of one bird, presumably the male. This activity consists of poking the other bird, moving over it to the other side, and side-stepping.

In the course of study information was gathered with regard to the breeding period of Cabanis's weaver. Even persons residing close to each other reported different breeding seasons for this species. Some claimed that the species nests throughout the year, others believed that the same nest is used by one pair after another; still others maintained that nesting is confined only to a few months of the year. The latter also differed with respect to the period in which the birds build their nests. Personal observation in a number of places in Rizal and Laguna Provinces indicates that the breeding season of *M. cabanisi* extends throughout the year, reaching its peak between the latter part of May and early August. There is a nesting rest period sometime between October and February. A pair raises more than one brood a year and may use the same nest again. The building of a new nest near an old one by the same pair was also noted. The change may be due to unfavorable elements in the old site.

The nests are built from about 3 meters to about 10 meters above the ground. They are usually seen in thin brush near open fields and in inhabited districts. Nests were noted in places as high as 80 meters above sea level. The record of this species in Benguet, giving an elevation of about 1,500 meters, suggests the possibility of its nesting in higher altitudes.

The gregariousness of this species is manifested even by nest building. Isolated nests, however, are not uncommon. In such cases the nest is always well concealed by the plant. This condition was observed in the nest found in an areca nut palm (*Areca catechu* Linn.), a royal palm (*Oreodoxa regia* HBK), a banana, a mango (*Mangifera indica* Linn.), a pili [*Canarium luzonicum* (Blume) A. Gray], a kallos (*Streblus asper* Lour.), a tamarind (*Tamarindus indica* Linn.), and a kamachili [*Pithecolobium dulce* (Roxb.) Benth.]. In July, 1926, thirty-four nests were counted in five citrus trees close to each other on the campus of the College of Agriculture, University of the Philippines. In the same place, July 12, 1933, Francisco Rivera noted ten nests in a balubo tree (*Diplodiscus paniculatus* Turcz.).

THE NEST

The nest (Plate 2) is about 20 centimeters long, with the opening at one end, somewhat retort-shaped with its long axis

horizontal. The distance between the outer surface of the bottom and that of the top is about 15 centimeters. Generally it is laterally compressed, the effect of the supporting branches probably being taken into account. The distance between the two sides is about 12 centimeters.

Bamboo leaves, ragged pieces of banana fiber, chicken feathers, and stalks, leaves, and inflorescences of weeds are used in nest construction. During the peak of the breeding season leaves and flowers of cogon (*Imperata cylindrica* Linn.) are abundant and are used largely as nesting materials.

The nest has an inner and an outer layer. The inner layer is more compact and made up of fine materials. The inside lining is made of finely woven pedicels of weeds. Oftentimes, especially during June, July, and August, flowers of cogon are laid inside the nest. These provide a comfortable, soft, warm lining for the young reared during the cooler months. The inner layer, when separated from the outer covering, has the shape of a gastrula whose blastophore is represented by the opening of the nest. This opening has a diameter of about 4 centimeters. The cavity has a diameter of about 7 centimeters. The inner layer is very distinct from the outer which defines the shape of the nest and which strengthens the nest through its materials that hold the nest against the supporting branches. The materials of the outer layer are loosely woven, making the nest oftentimes appear as a mere bulk of dried leaves. The fringing materials of the outer layer over the opening conceal this part from above and reduce its actual size. The opening is always away from the supporting branches and directed downwards.

The male and the female work together in building the nest. They alternately carry blades of grass from the ground to the nest site, although frequently one of them does the work alone, the other staying near the nest most of the time. The source of materials varies from about 5 meters to about 60 or even 80 meters away, depending upon the height and location of the nest. Generally, however, nesting materials are obtained from the neighborhood of the nest site, within a radius of from 10 to 20 meters. Observation shows that a nest could be built in an average of seven days.

The nest is constructed from outside inward, beginning with the fastening of the supporting branches. Materials are then added one by one until the soft lining is completed.

EGGS

Normally the clutch consists of five or six eggs. Rarely do four, seven, or eight eggs constitute the full complement of a set. The eggs are indistinguishable from those of *M. jagori*, described in a former paper (Manuel, 1930). The average measurement of fifty-four eggs is 16 by 11.3 millimeters.

YOUNG

Three or four young are generally hatched. These appear externally similar to those of *M. jagori* Manuel (1930), until their seventh day when they begin to differ in color and size. The young of Cabanis's weaver very gradually becomes Prout's brown above and matt snuff brown on the under surface. The tail gradually attains its yellowish olive tint. At seven days the young Cabanis's weaver is smaller than a Philippine weaver (*M. jagori*) of the same age.

FOOD AND FEEDING HABITS

Like that of other weavers, the food of Cabanis's weaver consists of seeds. However, the kind and amount of seeds taken differ in the various parts of its range and in different seasons of the year, with a consequent difference in economic effects.

FOOD OF THE YOUNG

The young feeds entirely on weed seeds. In this respect the weaver, together with the dove and pigeon (Judd, 1900), constitutes an exception to the general observation that nestling birds at first subsist on an animal diet. The kind and number of seeds depend largely upon the location of the nest and the activity of the parents. Observation on forty-seven young shows an average of about seventy seeds in a crop. As many as two hundred seeds were noted in one stomach. Data on the total number of seeds eaten by each nestling in one day are not available. Bailey (1905) hinted that birds with crop and stomach refill these twice a day. This is not applicable to young weaver nestlings, as they receive a supply of food from the adults at intervals many times during the day. The observations of Judd (1900), indicating the number of times nestling birds were visited in one day, even granting the estimate to be true with Cabanis's weavers, are of no value in determining the daily consumption of weed seeds by each young, since the number of seeds offered at one time was not noted. Unfor-

TABLE 1.—Food of *Cabanis's weavers* studied.

Date.	Province.	Town.	Collecting ground.	Birds obtained.	Composition of food.		Remarks.
					Cultivated (rice).	Uncultivated (mostly weed seeds).	
June 1932	Rizal	Novaliches	Vacant rice field; weeds in abundance.	32	Per cent. 0.1	Per cent. 99.9	Rice seed bed noted near one of the collecting grounds. Injurious.
June 1933	do.	Binangonan, Tanay, and Pililla.	All along shore of Laguna de Bay; rice in head	55	33.3	66.7	
July 1932	do.	Novaliches	Rolling open country	64	0.5	99.5	Seeds of bukai, a species of wild bamboo, were secured in one stomach.
July 1932	Butuan	San José del Monte	do.	4			
July 1933	Rizal	Alabang	Vacant rice field	6	0.01	99.99	Riceseedlings and rice in head in vicinity of collecting ground in Biñan.
July 1933	do.	Novaliches	do.	19			
July 1933	Laguna	Los Baños	do.	24	5.4	94.6	In Pila birds were suspected of feeding on rice in seed beds.
July 1933	do.	Bay	do.	7			
Aug. 1932	do.	Biñan	do.	15	0.00	100.00	
Aug. 1932	do.	Los Baños	do.	4			
Aug. 1932	do.	Pila	do.	14	2.22	97.78	
Aug. 1932	Tayabas	Mauban	do.	6			
Aug. 1932	Batangas	Balayan	Rice in head	2	0.00	100.00	
Aug. 1932	do.	Lipa	Near upland rice in head	1			
Aug. 1932	do.	Tanauan	Rice in head and gabi plantation on a plateau.	6	0.00	100.00	
Aug. 1933	Rizal	Novaliches	Vacant rice field weeds in abundance.	7			
Sept. 1932	Laguna	Los Baños	Rice in head noted in vicinity	18	2.22	97.78	

Date	Locality	Description	No. of birds	Percentage of food composition from each collecting ground depends directly on the availability of the food plant.	Injurious.
Oct. 1932	Bulacan	Near rice in bloom	48	1.18	98.82
Oct. 1932	Makinabang	Vacant rice field; about 2 km from rice in head	32		
Oct. 1932	Pullian	Vacant rice field	16		
Oct. 1932	Quingua	do	4		
Oct. 1932	San Ildefonso	Rice in field; grain in head	19	1.18	98.82
Oct. 1932	San Rafael	Near rice in head	1		
Oct. 1932	Baliuag	Vacant rice field; about 4 km from rice in head	24		
Oct. 1932	Bustos	Rice in head	16		
Oct. 1932	Apalit	Near rice in head	5	1.18	98.82
Oct. 1932	Angelo	Vacant rice field near rice in head	7		
Oct. 1932	San Fernando	Near rice in head and in fields away from this	18		
Oct. 1932	Cabanatuan	Rice not in head	7		
Oct. 1932	Talavera	Vacant rice field; about 3 km from rice in head	6	1.18	98.82
Oct. 1932	Santa Rosa	Rice in head	15		
Oct. 1932	Gapan	Near rice in head	6		
Oct. 1932	Bamban	do	5		
Oct. 1932	Capas	Rice in head	2	20.23	79.77
Oct. 1932	Murcia	Rice ready for harvest	12		
Oct. 1932	Makati	do	15		
Oct. 1932	Novaliches	Near rice in head	29		
Oct. 1932	San Pedro Makati	do	12	12.93	87.07
Oct. 1932	Novaliches	Near rice in head	15		
Oct. 1932	Alabang	Newly harvested rice field	1		
Oct. 1932	Infanta	do	4		
Oct. 1932	Subic	do	5	17.42	82.58
Oct. 1932	San Pedro Makati	do	1		
Oct. 1932	San Pedro Tunasan	Vacant rice field	4		
Oct. 1932	San Pedro Makati	Newly harvested rice field	12		
Oct. 1932	Baliuag	do	12	12.41	87.59
Oct. 1932	Pullian	do	31		
Oct. 1932	Apalit	do	6		
Oct. 1932	San Luis	do	6		

TABLE 1.—Food of *Cabanis's weavers studied*—Continued.

Date.	Province.	Town.	Collecting ground.	Birds obtained.	Composition of food.		Remarks.
					Cultivated (rice).	Uncultivated (mostly weed seeds).	
Mar. 1933	Bulacan.	Baliuag.	Rice in head.	4	Per cent. 75.00	Per cent. 25.00	Injurious, but samples were inadequate.
Mar. 1934	Laguna	Pansol.	Vacant rice fields.	8			
	do.	Calamba.	By a field; rice in head.	18			
	do.	Cabuyao.	Vacant rice field; about 3 km from rice field.	6	28.08	71.92	Injurious.
	do.	Bifan.	Rice in head.	13			
	do.	San Pedro Tunasan.	do.	23			
	Rizal.	Muntinlupa.	Vacant rice field.	14			
Apr. 1933	do.	Alabang.	do.	1	100.00		
Apr. 1934	Laguna.	Cabuyao.	Newly harvested rice field.	14			Injurious, but sample was inadequate.
Apr. 1934	Rizal.	Alabang.	Vacant rice field.	8	1.76	98.24	
May 1933	do.	Novaliches.	do.	1			
May 1933	Laguna.	Los Baños.	do.	4			
May 1933	Bulacan.	Baliuag.	Rice in head.	8	19.06	80.94	
May 1933	Pampanga.	Apalit.	do.	4			

tunately, the number of seeds given at one time cannot be accurately determined.

The male and the female Cabanis's weavers take turns in feeding the young. The food is given by the parents in pellets and the seeds are obviously devoid of coats when offered.

FOOD OF ADULTS

Determination of the food of adult birds was largely based on the results of stomach examination. Collection was begun from vacant rice fields in Novaliches, Rizal Province, in June, 1932, when thirty-two birds were secured in three days. Weeds were in head and the birds were seen feeding on them. The presence of a rice seed bed near one of the collecting grounds probably accounts for the presence of rice seeds in two stomachs in combination with weed seeds. Rice seeds comprised 0.1 per cent of the total food. Two stomachs were empty. The other stomachs all contained weed seeds, with sabung-sabuñgan (*Panicum flavidum* Retz.) in the majority of them. This weed comprised 95.8 per cent of the weed food of the birds examined for this month.

Examination of the stomach contents of birds obtained in June, 1933, from the towns of Binangonan, Tanay, and Pililla, along the shore of Laguna de Bay in Rizal Province, yielded different results. Collecting was done in places near rice in head. With the exception of one empty stomach the stomachs of the fifty-five birds collected contained 33.3 per cent rice, the balance consisting of weed seeds. Of the weed seeds those of daua-dauahan (*Panicum crus-galli* Linn.) formed 78.8 per cent; sabung-sabuñgan, 20 per cent; tiribuhan (*Panicum colonum* Linn.) and amor seco (*Andropogon aciculatus* Retz.), a little over 1 per cent.

Material for July, 1932, was obtained from Novaliches, Rizal Province, and from San Jose del Monte, Bulacan Province. These two places are situated near each other in rolling, open country with uniform ecological conditions. The region, at the time, was largely cogonal with an occasional patch of upland rice. Sixty-eight Cabanis's weavers were collected during the month. The stomachs of seven birds were empty. The stomach contents of sixty-one birds yielded 0.5 per cent rice, seeds of seven species of weeds, and bokáui [*Schizostachyum lumampao* (Blco.) Merr.], a species of wild bamboo, representing 99.5 per cent. Of the uncultivated species, seeds of sabung-sabuñgan and

paragis (*Paspalum scrobiculatum* Linn.) made up the greater part, being 51.8 per cent and 26.6 per cent, respectively. Other weeds recovered were amor seco, tiribuhan, daua-dauahan, and laau-laau (*Paspalum conjugatum* Berg.). Bokáui constituted 3.4 per cent of the uncultivated plants.

Data for July, 1933, were secured from stomachs of birds collected from Alabang and Novaliches, Rizal Province, and from Los Baños and Bay, Laguna Province.

Six birds collected in a vacant rice field in Alabang all had daua-dauahan in their stomachs.

From Novaliches nineteen birds were studied. Collecting was done in a vacant rice field where weeds were in abundance, which probably accounts for all the stomachs but one having weed seeds. Rice was noted mixed with weed seeds in one stomach. The same condition obtained in thirty-one stomachs from Los Baños and Bay.

An estimate based on the data obtained for this month gave the food as being about 0.01 per cent rice and 99.99 per cent weed seeds.

Seven places in three provinces were visited for observation and collection of materials in August, 1932. From Laguna Province, collecting was done in Biñan, Los Baños, and Pila. In Biñan fourteen birds were collected within two days. Rice seedlings were being transplanted around the collecting place at the time, but rice in head was noted about 2 kilometers away. Four stomachs were empty. Two stomachs contained rice seeds, the rest weed seeds. All four birds collected in a vacant rice field in Los Baños had eaten weed seeds. The birds secured in lowland rice fields in Pila perhaps fed on nongerminating rice seeds, since birds shot in paddies where rice seedlings were being transplanted had this grain in seven of fourteen stomachs. The birds were noted on the fence inclosing the seed bed. Alleged feeding in seed beds causes this bird to be regarded with disfavor. This assumption, however, awaits confirmation. Two stomachs were empty. Weed seeds, some mixed with rice, were found in twelve stomachs. The contents of the stomachs of six Cabanis's weavers shot in Mauban, Tayabas Province, were weeds. One stomach was empty.

In Batangas Province, Cabanis's weavers were collected in the municipalities of Balayan, Lipa, and Tanauan.

Weeds were recovered from the stomachs of two birds obtained near rice in head in Balayan. In Lipa a bird shot near a rice field in head had rice in its stomach. Of six Cabanis's

weavers obtained on a plateau in Tanauan two had empty stomachs and four had eaten rice. In two of the four stomachs weed seeds were recovered in addition. The field visited by Cabanis's weaver and *Munia jagori* was planted to upland rice in head. In the neighborhood was a gabi [*Colocasia esculentum* (Linn.) Schott] plantation in which weeds were growing abundantly. The birds moved back and forth between the gabi and rice fields.

The food of Cabanis's weaver for this month as shown by the materials studied consisted of 5.4 per cent rice and 94.6 per cent weed seeds. Tiribuhan, sabung-sabunġan, and amor seco were the major weed items, while daua-dauahan, paragis, and luya-luyahan (*Panicum repens* Linn.) were represented to a lesser extent.

Observation and collection of Cabanis's weaver for August, 1933, were confined to Novaliches, Rizal Province. The stomachs of seven birds obtained in open fields where weeds were in abundance contained weed seeds. Tiribuhan and amor seco were the weeds noted.

All material for September, 1932, was obtained in Los Baños, Laguna. A number of paddies with rice ready for harvest were in the vicinity of the collecting grounds. Eighteen stomachs were dissected, five of which were empty. Rice seeds mixed with weed seeds were obtained from four stomachs. Seeds of seven species of weeds were identified from the contents of thirteen stomachs. It was estimated that rice made up 2.22 per cent of the stomach contents and weed seeds 97.78 per cent.

The largest number of stomachs of Cabanis's weaver examined for any one month was that for October, 1932. The materials were from seventeen places in four provinces. Various types of conditions prevailed in the different collecting places. In all two hundred thirty-one stomachs of Cabanis's weavers collected during the month were studied.

In Bulacan Province material was obtained from Makinabang, Baliuag, Pulilan, Quingua, San Ildefonso, San Rafael, and Bustos. From Makinabang forty-eight birds were collected. Rice was noted mixed with weeds in the stomachs of three of these. The others had eaten weeds in different combinations and various quantities. The birds were shot near rice fields when the plants were about to bloom. In Pulilan the birds were obtained in vacant fields about 2 kilometers away from rice in head. Rice was recorded in one stomach among thirty-two that have been examined from this place. Weed seeds were the con-

tents of the other stomachs. From Quingua sixteen stomachs were examined; all contained weed seeds. Four birds were obtained from San Ildefonso. One stomach was empty, while weeds were recorded from three. Collecting in a field when rice was in head in San Rafael must have been the cause of the presence of rice in twelve stomachs out of nineteen. The grain was mixed with weed seeds in eight of that number, thus weed seeds were recorded in fifteen stomachs. The stomach of a lone bird from Baliuag contained rice and tiribuhan. Field work in Bustos resulted in the collection of twenty-four Cabanis's weavers. Collecting was done in a vacant rice field about 4 kilometers from fields where the grain was in head. The stomachs of five birds were empty. Rice was noted in five stomachs. Weed seeds were recovered from fifteen birds.

Twenty-eight stomachs were examined from the municipalities of Apalit, Angeles, and San Fernando in Pampanga Province. Eleven of the sixteen stomachs of Cabanis's weaver studied from Apalit contained rice. The presence of this grain in so many stomachs is attributable to the fact that collecting was done on the edge of a rice paddy, when the grain was in head. In seven of the stomachs rice was noted mixed with weeds, thus weeds were recovered in twelve stomachs. Five weavers were secured in a rice field in Angeles, four of which had rice in their stomachs. Weed seeds were also recorded in three of them. One was empty. In five of seven stomachs collected in San Fernando rice was recorded. Weed seeds were noted in four of these in combination with rice. Altogether, weeds were recorded in six stomachs.

In Nueva Ecija samples were obtained from the municipalities of Cabanatuan, Talavera, Santa Rosa, and Gapan. From a place in Cabanatuan near a rice field in head, ten stomachs were examined. Nine contained rice. Two species of weeds were noted in one stomach. In another place in the same municipality, collecting was done away from rice fields. The contents of all eight stomachs examined were weeds. Seven birds were secured near a rice field not in head in Talavera. Except in one stomach where rice was recorded in combination with weed seeds, all contained the latter item. Rice was recovered from two, while in five of the six stomachs studied from Santa Rosa weeds were noted. In Gapan fifteen Cabanis's weavers were collected in a field of rice in head. Two of the stomachs were

empty. Rice was found in eight stomachs, in six of which it was mixed with weeds. Amor seco and daua-dauahan were the weeds noted.

Thirteen stomachs of this weaver were studied from the municipalities of Bamban, Capas, and Murcia in Tarlac Province. Rice was recovered in all six stomachs obtained in Bamban. In Capas two of five stomachs were empty. Rice was recorded in three stomachs, in one of which the grain was mixed with a species of weed known as malakauayan (*Panicum reptans* Linn.). Rice was recovered from the two stomachs of weavers secured at Murcia.

An estimate made of the data obtained from the material secured in October, 1932, shows that ten species of weeds comprised 98.82 per cent of the food. The balance of 1.18 per cent was represented by rice. Amor seco and daua-dauahan were the two most important food items for the month, as they represented 69.17 per cent and 26.93 per cent, respectively, of the weed seeds eaten.

For November, 1932, fifty-six birds were collected in Make-tipo, Novaliches, and San Pedro Makati, all in Rizal Province, when rice was ready for harvest. From Maketipo twelve stomachs were examined. From six of these rice was recovered; three contained weed seeds in addition. Weeds were recorded from eight stomachs. One stomach was empty. All fifteen stomachs obtained from Novaliches contained rice and weeds in combination. Twenty-nine stomachs were studied from San Pedro Makati. Rice was noted in twenty-four of them, while weeds were observed in eleven. Deviation from the total number is due to two empty stomachs and the combination of rice and weed seeds in nine stomachs.

The data obtained yielded the following results: Rice, 20.23 per cent; weed seeds, 79.77 per cent. Amor seco and daua-dauahan were the two important weed items, constituting 56.90 per cent and 39.36 per cent, respectively, of the weed seeds eaten.

The birds studied for December, 1932, were obtained from widely scattered regions.

The food of twelve birds from two collecting places in Novaliches, Rizal Province, were studied. Rice was noted in nine, in six of which the grain was mixed with weed seeds. Two stomachs contained nothing but weed seeds. One was empty.

In Alabang, Rizal Province, fifteen weavers were obtained while rice was being harvested. Rice was secured from seven stomachs. Weed seeds were noted in twelve stomachs, in five of which they were mixed with rice. One was empty.

A bird caught in a newly harvested rice field in Infanta, Pangasinan Province, had rice, amor seco, and daua-dauahan, in its stomach.

Four birds secured in a newly harvested rice field in Subic, Zambales Province, had fed exclusively on rice.

The results of the examination of thirty-two stomachs of Cabanis's weavers collected in December, 1932, in Rizal, Zambales, and Pangasinan Provinces are as follows: Rice, 12.93 per cent; seeds of five species of weeds, 87.07 per cent.

Cabanis's weavers for January, 1933, were obtained on rice stacks in San Pedro Makati, Rizal Province. The birds were observed feeding on the stored grain. Five stomachs were examined, and rice mixed with weed seeds was found in all of these. Numerically, rice constituted 17.42 per cent and amor seco, 82.58 per cent.

The stomach of a bird obtained in a newly harvested rice field in San Pedro, Laguna, in January, 1934, contained 15.84 per cent rice and 84.16 per cent weed seeds.

In February, 1933, sixty-five stomachs of birds collected in Rizal, Bulacan, and Pampanga Provinces were studied. All four birds from San Pedro Makati, Rizal, had fed on rice. They were shot on a rice stack.

In Bulacan collecting for the month was done in Baliuag and Pulilan. Rice was noted in eleven of the twelve stomachs from Baliuag. One was empty. Weed seeds, chiefly of amor seco, were found in combination with rice in six stomachs. The twelve birds from Pulilan had rice in their stomachs. In six stomachs rice was mixed with weeds.

In Pampanga birds for this month were taken at Apalit and San Luis. The stomachs of thirty-one birds collected in a newly harvested rice field in Apalit were studied. Rice was recovered from twenty-two of that number, including seventeen where it was mixed with weed seeds. Weed seeds, principally daua-dauahan, were noted in twenty-six stomachs. Five of the six weavers shot in a newly harvested rice field in San Luis had fed exclusively on rice. One had nothing but daua-dauahan in its stomach.

An estimate based on the data obtained in February, 1933, indicated that rice made up 12.41 per cent of the food, and the balance of 87.59 per cent was represented by weed seeds. Daua-dauahan and amor seco were the important weed foods for this month.

Two of four birds shot in Baliuag, Bulacan Province, in March, 1933, had a mixture of rice and weed seeds in their stomachs. The stomachs of two others were empty. The figures for this month show that 75 per cent of the food taken was rice, while weed seeds constituted 25 per cent.

Rather extensive collecting was done in March, 1934, when eighty-two stomachs from Laguna and Rizal Provinces were examined. In Laguna the birds were obtained from Pansol, Calamba, Cabuyao, Biñan, and San Pedro.

Of the eight birds collected in Pansol, five had fed on rice. In two of these the grain was mixed with weed seeds. Weed seeds were also recorded from others. Birds shot near a rice field in Calamba had largely fed on rice. Eighteen birds were obtained, and the stomachs of all except one contained rice. Weed seeds were noted in seven stomachs. Six birds obtained in Cabuyao had fed on a mixture of rice and weed seeds. From Biñan thirteen birds were secured for study during the month. All had eaten rice. Weed seeds were recovered, in addition to rice, in nine stomachs. In all twenty-three stomachs collected from San Pedro rice was recorded. Weed seeds were mixed with rice in nine of these.

In Rizal Province the materials were obtained from Muntinlupa. One stomach was empty, while thirteen weavers from Muntinlupa had fed on rice. In addition to rice, weed seeds were also noted in eleven stomachs.

Stomachs of weavers collected in March, 1934, contained 28.08 per cent rice, while seeds of seven species of weeds represented 71.92 per cent. The recovery of rice seeds in the stomachs of many birds, particularly those collected in Calamba, Cabuyao, Biñan, and San Pedro, all in Laguna Province, may be attributed to the fact that the grain was in head in those places.

Only one bird was secured for this study in Alabang, Rizal Province, in April, 1933. Its stomach contained seven seeds of rice.

In April, 1934, twenty-two birds were collected in Cabuyao, Laguna Province, and Alabang, Rizal Province. Eight of fourteen birds from Cabuyao had fed on rice, seven of which had

also taken weed seeds. Six had fed exclusively on tiribuhan. All eight birds from Alabang had fed on tiribuhan. In addition, two birds had also taken rice.

The records for this month show that rice made up 1.76 per cent and weed seeds constituted the balance of 98.24 per cent. Of the weed seeds, tiribuhan constituted 92.18 per cent, amor seco representing the balance of 7.82 per cent.

The data for May, 1933, were obtained from Rizal, Laguna, Bulacan, and Pampanga Provinces.

One bird from Novaliches, Rizal Province, had taken rice entirely.

Three of the birds from Los Baños, Laguna Province, had both rice and weed seeds in their stomachs. One stomach was empty.

Six of eight stomachs from Baliuag, Bulacan, contained rice. Weed seeds were noted also in six stomachs.

All four birds collected in Apalit, Pampanga Province, during this month had fed on rice. In addition, two of the stomachs contained amor seco. These records show that the food of the birds examined for this month consisted of 19.06 per cent rice and 80.94 per cent weed seeds.

Numerically, the stomach contents of eight hundred birds which were collected from over one hundred places in forty-one municipalities belonging to ten provinces during a period of eighteen months in three years were 3.91 per cent rice and 96.01 per cent weed seeds (seeds of a species of wild bamboo recovered in one stomach included in the latter item). The economic value of weed seeds has been discussed in a previous paper (Manuel, 1934) wherein it was also indicated that the birds feeding on weed were of neutral importance.

Field observations revealed that flocks of Cabanis's weavers oftentimes with Philippine weavers frequent rice fields when the grain is in head. This is confirmed by the results of the examination of stomachs of birds collected when the grain was about to be harvested. Visits of these birds to the fields generally occur early in the morning and late in the afternoon, obviously to evade the heat of the day. Generally, these visits cause some damage to the crop, considering that one bird can eat ninety-two seeds of rice, as was noted in this study from a bird collected in Apalit, Pampanga. In fields where panicles of daua-dauahan overgrow those of rice, weavers alight on the weed plant first. This observation proves an assertion (Manuel, 1934) regarding the relation of Philippine weavers to the

rice plant as affected by this weed. A plant ordinarily harbors two or three birds. Those in excess of this number move to the closest rice plant.

SUMMARY AND CONCLUSIONS

1. Cabanis's weaver, *Munia cabanisi* Sharpe, is one of the weaver birds condemned by rice growers in the Philippines as causing damage to crops. This bird has several vernacular names, all of them implying deafness.

2. *Munia cabanisi* is an endemic species, very likely confined to Luzon.

3. The species is monogamous. The pairs are seen together while feeding; they help each other in building the nest and in feeding their young.

4. More than one brood is produced annually by each pair.

5. Nesting occurs throughout its range and is continuous during the year, reaching its peak between late May and early August. There appears to be a localized nesting rest period sometime between October and February.

6. Nests are built from about 3 meters to about 10 meters above the ground. Nests were noted in places about 80 meters above sea level.

7. Nests are usually built in colonies. When isolated, a nest is well concealed in the thick foliage of its host plant.

8. The nest is retort-shaped and consists of two layers—an inner compact layer of fine materials and an outer layer of loosely set materials. Nest building starts from outside and proceeds inward.

9. A clutch consists of five or six eggs. Three or four young are generally hatched from one set of eggs.

10. Cabanis's weaver nestlings feed entirely on weed seeds. An average of about seventy seeds was estimated to be the content of the crop at one time.

11. Stomachs of eight hundred adult birds from ten provinces collected during eighteen months in three years were studied.

12. The food of adults consists of seeds of rice and of weeds. Numerically, the food consists of 96.01 per cent weed seeds and 3.91 per cent rice seeds.

13. Flocks of Cabanis's weavers frequently visit rice fields when this grain is in head. During this period the percentage of rice in the food of the birds is higher than at other times.

14. Where daua-dauahan overgrows rice, the bird alights on the weed plant first and prefers the seed of this weed to that of the cultivated rice plant.

The present study shows that Cabanis's weavers destroy a large quantity of weed seeds annually in Luzon where they are confined, due to the fact that weed seeds form the entire food of young weavers, which are hatched continuously. In addition weed seeds form the greater part of the food of adults. When rice is in head, however, Cabanis's weavers, to a certain extent, feed on this grain and should not be allowed to alight in the field, as repeated visits of large flocks will result in significant harm to the crop.

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ILLUSTRATION

PLATE 1

- FIG. 1. *Munia cabanisi* Sharpe, Cabanis's weaver, adults.
2. Nest of Cabanis's weaver.



1



2

PLATE 1.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXVII¹

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

FOUR PLATES

The majority of the crane flies discussed herewith are from various parts of the Japanese Empire, including the northern Kurile Islands, Manchoukuo, Korea, the main islands of Japan, and Formosa, where they were collected by my friends Messrs. Esaki, Gressitt, Hibi, Issiki, Machida, and Miyadi. The types resulting from the above material are preserved in my collection through the continued friendly interest of the entomologists mentioned. Other species are from western China, collected by the Rev. David C. Graham, preserved in the United States National Museum; in eastern Siberia, in the Russian Academy of Sciences, received through Dr. A. von Stackelberg; and from Siam, in the American Museum of Natural History, through Dr. C. Howard Curran. I wish to express my deepest thanks to all of the above-mentioned entomologists for this further coöperation in studying the tipulid fauna of eastern Asia.

TIPULINÆ

CTENACROSCELIS IGNICAUDATUS sp. nov. Plate 1, fig. 1; Plate 2, figs. 25 to 27.

Belongs to the *brobdignagius* group; mesonotal præscutum dark clove brown, with four relatively narrow grayish brown stripes; margin of præscutum dark; antenna with flagellar segments subcylindrical; pronotum dark brown above, broadly light yellow on sides; pleura chiefly yellow, with a narrow, dorsal, dark brown stripe and a small brown area on sternopleurite; femora reddish brown, the basal fifth or sixth blackened, the tip undarkened; wings with a strong reddish brown suffusion, the prearcular region darker; basal abdominal tergites dark brown, the outer segments and hypopygium brightened to fulvous.

¹ Contribution from the entomological laboratory, Massachusetts State College.

Male.—Length, about 30 millimeters; wing, 38.

Frontal prolongation of head brown, more brownish black on sides; palpi black throughout; nasus distinct. Antennæ with scape and pedicel brownish yellow; basal flagellar segment slightly darker, the outer segments dark brown; flagellar segments subcylindrical (Plate 2, fig. 25), ventral face very little produced; verticils numerous, shorter than the segments. Head brown.

Pronotum dark brown above, broadly light yellow on sides. Ground color of præscutum dark clove brown, with four relatively narrow, more grayish brown stripes; margin of præscutum unbrightened; scutum dark brown, the lobes variegated by more grayish brown; scutellum brown; mediotergite paler, more grayish yellow, but uniform in color. Pleura chiefly yellow, the dorsopleural area more brightly so; a narrow dark brown dorsal stripe extending from the cervical region along the dorsal pleurites to and including the pteropleurite; a small, isolated, brown spot on sternopleurite. Halteres brownish black, the extreme base of stem reddish. Legs with the coxæ testaceous-yellow, the fore and middle coxæ more darkened; trochanters reddish brown; femora reddish brown, the basal fifth or sixth black; tibiæ and basitarsi reddish brown, the outer tarsal segments brownish black. Wings (Plate 1, fig. 1) with a strong reddish brown suffusion, the costal region and cubital and anal veins more fulvous; stigma a very little paler yellow than the ground; prearcular region more infuscated; restricted oblitative areas before cord and beyond stigma; outer branches of M and Cu, with vein 2d A, narrowly seamed with brown; axilla narrowly darkened; veins reddish brown. Venation: m-cu about equal to distal section of Cu₁, cell M₄ thus being nearly as wide as long.

Basal abdominal tergites uniformly dark brown; outer two or three segments brightened to fulvous. Male hypopygium with the tergite (Plate 2, fig. 26, 9*t*) elongate, the caudal margin with a rather shallow V-shaped emargination, the distal third of sclerite with setæ that become longer and more conspicuous on outer lateral angles but do not form distinct tufts or pencils. Outer dististyle (Plate 2, fig. 27, *od*) shaped more or less like a dog's ear; inner style, *id*, long and slender, with abundant long erect setæ on basal third or more, the proximal end dilated. Eighth sternite (Plate 2, fig. 26, 8*s*) with very abundant sternal setæ, culminating in long yellow tufts on either side of a glabrous median emargination.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 5,500 to 11,000 feet, August 16 to 20, 1934 (*Graham*).

I hesitate to place this very distinct species in any of the groups defined by Edwards.² It fits best in the *brobdignagius* group, to which I am referring it, but with some slight question. The fly has the præscutal margins darkened and has a brown area on the sternopleurite. The black bases to the otherwise reddish brown femora are very conspicuous. In some details of coloration, the species agrees with the Oriental *Ctenacroscelis dives* (Brunetti), differing most conspicuously in the structure of the antennæ and the coloration of the legs.

CTENACROSCELIS LIBERTUS sp. nov. Plate 2, fig. 28.

Belongs to the *brobdignagius* group; pronotum weakly infumed on median portion, passing into orange-yellow on sides; præscutal stripes dark olive-green, bordered by slightly paler, nearly confluent; a capillary black median vitta on cephalic portion of sclerite; scutellum and mediotergite dark; pleura orange-fulvous, with a dorsal dark brown line from the cervical region to below the wing root; tips of femora dark brown; wings with a strong brownish yellow tinge; anterior prearcular field and costal region, together with stigma, darker brown; darker clouds in centers of outer medial field; abdominal tergites dark brown, basal sternites yellow; male hypopygium with the inner dististyle relatively short-stemmed, the apical beak unequally bifid.

Male.—Length, about 28 millimeters; wing, 33.

Frontal prolongation of head dark brown; nasus long and conspicuous; palpi dark. Antennæ with the scape brown; pedicel more brownish testaceous; flagellum broken. Head brownish gray, unmarked.

Pronotum weakly infumed on median portion, passing into orange-yellow on sides. Mesonotal præscutum rather broadly yellow laterally, the color continued around the front border of the sclerite, interrupted by a capillary black median vitta on cephalic portion of sclerite; præscutal stripes confluent or with the interspaces scarcely apparent; stripes dark olive-green, vaguely bordered by slightly paler; dark color not variegated by orange before the suture, as in *majesticus*; scutal lobes chiefly olive-green, the median area more reddish brown; scutellum dark brown; mediotergite brownish gray, with a very delicate median brown vitta. Pleura orange-fulvous, with a dark

² *Stylops* 1 (1932) 145-146.

brown dorsolongitudinal stripe beginning on the cervical sclerites, crossing the propleura, dorsal anepisternum and pteropleurite, becoming more expanded surrounding the wing base; dorsopleural region extensively orange; ventral pleurites uniformly pale. Halteres black, the base of stem narrowly pale. Legs with the coxæ and trochanters pale; femora brownish yellow, the tips rather narrowly darker brown but not blackened; tibiæ yellow, the tips more narrowly dark brown; tarsi passing into black; claws (male) toothed. Wings with a strong brownish yellow tinge, the anterior prearcular field and costal border darker, best evidenced by the black veins of the prearcular field; stigmal area about as dark as the costal border; somewhat darker clouds in outer end of cell M and as centers to the outer medial cells, this coloration possibly abnormal and in any case discolored by a purplish stain in the unique type; anterior and posterior cord weakly bordered by darker; veins brownish yellow. Venation: Cell M_1 short-petiolate, the petiole only about one-third of m ; $m-cu$ very close to fork of M_{3+4} , subequal to distal section of Cu_1 , cell M_4 thus markedly deeper than in *fulvolateralis*.

Abdominal tergites dark brown, the basal sternites abruptly light yellow. Male hypopygium with the ninth tergite (Plate 2, fig. 28, 9*t*.) having a shallow V-shaped notch, the lateral lobes obtuse; on dorsal surface of each lobe a second lower lobule with a brush of setæ distinct from the group at apex of the lobe itself. Outer dististyle, *od*, with the apex obtuse. Inner dististyle, *id*, with the stem relatively short and stout, the apex dilated, in profile appearing somewhat like a flamingo's head; additional to the primary decurved hooklike point is a smaller lateral one; at base of stem a dilated lobe, with coarse erect setæ. Eighth sternite rather strongly produced ventrad; caudal margin transverse or convexly rounded, with inconspicuous groups of yellow setæ on outer lateral portions, these lines continued cephalad on face of sclerite.

Habitat.—China (Szechwan).

Holotype, male, Wei Chow, 65 miles northwest of Chengtu, altitude 5,000 to 8,000 feet, July 25, 1933 (*Graham*).

The nearest allies of the present species are *Ctenacroscelis fulvolateralis* (Brunetti) and *C. majesticus* (Brunetti), of the Himalayan region of northern India. The latter species differs in the structure of the hypopygium and in details of coloration, especially the lack of a brown pleural stripe and the presence of a conspicuous orange spot on the præscutum before the suture.

From *fulvolateralis*, the present fly differs in the coloration of the body, femora, and wings and in the details of venation.

CTENACROSCELIS QUADRIFASCICULATUS sp. nov. Plate 1, fig. 2; Plate 2, figs. 29 and 30.

Belongs to the *serratus* group; mesonotal præscutum olive, with three more greenish stripes; scutellum and mediotergite orange; pleura orange-fulvous, with a conspicuous whitish longitudinal stripe; trochanters black; femora bright reddish, their bases narrowly blackened; wings fulvous-brown; cell M_1 short-petiolate; abdominal tergites dark reddish brown; male hypopygium with the sternite and basistyle only slightly produced, the latter emarginate at apex, each lobe with brushes of long, yellow setæ.

Male.—Length, about 25 millimeters; wing, 31.5.

Frontal prolongation of head long and slender, considerably exceeding the remainder of head, reddish brown, darker on sides; nasus conspicuous, depressed. Antennæ with scape and pedicel brown, the flagellum somewhat paler brown; first flagellar segment long and slender (Plate 2, fig. 29), subequal to the scape; intermediate flagellar segments strongly produced on ventral surface, much as in *serratus*, the serration most strongly developed on flagellar segments three to six, inclusive. Head grayish brown, the anterior vertex clearer gray.

Pronotum dark brown medially above, paler on sides. Ground color of præscutum olive, with three even more greenish stripes that are narrowly bordered by more grayish; lateral borders of præscutum castaneous; scutal lobes greenish, the median area restrictedly yellow; scutellum and mediotergite orange, the latter more whitish on posterior half. Pleura with the ground color orange-fulvous, with a conspicuous whitish longitudinal stripe, extending from behind the fore coxæ to the base of abdomen, widened posteriorly, narrowly bordered above on anepisternum and more extensively along ventral edge by darker brown; dorsopleural membrane pale. Halteres brownish black, the base of stem restrictedly reddish. Legs with the coxæ chestnut, the middle and hind pair paler at tips; trochanters black; femora bright reddish, the bases narrowly blackened, the tips scarcely darker; tarsi broken beyond second segment, the basal portion light brown. Wings (Plate 1, fig. 2) with a strong fulvous brown tinge, cell Sc clearer yellow; centers of the cells somewhat paler; wing base narrowly blackened; veins bright yellow. Venation: Cell M_1 with petiole about one-half m.

Abdominal tergites with basal two segments chestnut-brown, the lateral borders narrowly pale; median line of first tergite yellow; outer segments somewhat darker reddish brown. Male hypopygium (Plate 2, fig. 30) with the tergite, *9t*, relatively short, the median notch shallower than in *serricornis*, the lateral lobes obliquely truncated, with abundant erect black setæ. Basistyle, *b*, not long-produced, the apex deeply emarginate to form two lobes, the upper or more dorsal a little more truncated, both lobes with brushes of long yellow setæ. Outer dististyle, *od*, moderately wide. Inner dististyle, *id*, long and slender, the apex suddenly narrowed, curved, set with five or six erect spines. Eighth sternite, *8s*, without special armature.

Habitat.—China (Szechwan-Tibet Border).

Holotype, male, Mupin, altitude 3,500 feet, June, 1929 (Graham).

The present fly is most readily told from *Ctenacroscelis serricornis* (Brunetti) by the structure of the male hypopygium, especially the long hair brushes at apex of each basistyle.

CTENACROSCELIS REGIUS sp. nov. Plate 2, fig. 31.

General coloration of head and thorax orange, the latter unmarked except for four pale brownish gray stripes on præscutum and similarly colored areas on scutal lobes; flagellar segments cylindrical or virtually so, with short verticils; wings long and narrow, deep fulvous, the small stigmal area slightly more yellowish; cell *M*₁ petiolate; abdominal tergites chiefly brown; ovipositor with the cerci gently decurved at tips.

Female.—Length, about 45 millimeters; wing, 48.5 by 8.

Frontal prolongation of head relatively long, deep orange; nasus unusually long, subequal in length to the antennal scape; palpi with basal three segments brown, the incisures of the second and third segments restrictedly pale; terminal segment black. Antennæ yellowish orange, the outer flagellar segments scarcely darker; flagellar segments cylindrical or virtually so (Plate 2, fig. 31); setæ abundant but short, the terminal two segments with the setæ longer and more conspicuous. Head deep orange; vertical tubercle low, entire.

Pronotum orange. Mesonotal præscutum orange with four pale brownish gray stripes that are little-apparent against the ground, the mesal margins of the intermediate pair narrowly bordered by brown, more intense in front; posterior sclerites of notum orange or orange-fulvous, each scutal lobe with two

confluent pale brownish gray areas. Pleura uniformly yellow. Halteres brown, the base of stem narrowly orange. Legs with the coxæ and trochanters yellow; femora orange, the tips very insensibly more fulvous, the ctenidium black; tibiæ and tarsi orange, the terminal tarsal segments passing into dark brown. Wings long and narrow, as shown by the measurements, the width almost uniform for most of the length; membrane deep fulvous, the small stigmal area slightly more yellowish; veins horn yellow. Venation: Rs subequal to R_{2+3} ; r-m a little shorter than the basal section of R_{4+5} ; petiole of cell M_1 exceeding one-half m; m-cu a short distance before fork of M_{3+4} , slightly longer than the distal section of Cu_1 ; basal third of cell 2d A lying proximad of level of arculus.

Abdomen with sides of first tergite yellow, the median area and succeeding tergites medium brown, the lateral borders a trifle more grayish, bordered internally by vague dusky lines, more evident on the subterminal segments; sternites a trifle more yellowish brown. Ovipositor with the cerci deep castaneous, blackened basally, the tips gently decurved.

Habitat.—Siam.

Holotype, female, Chieng-mai, October 27, 1920 (in American Museum of Natural History).

The nearest ally of the present fly seems to be *Ctenacroscelis rex* Alexander, of Burma,³ which differs most evidently in the grayish black præscutal stripes and similarly colored areas on the scutal lobes. I cannot place the present fly in any of the groups of the genus defined by Edwards.⁴ In its major size it agrees with the *brobdignagius* group but differs in all details of coloration, while the long conspicuous nasus excludes it from the *monochrous* group. Because of lack of specimens I cannot say whether or not *Ctenacroscelis rex* has the nasus present or lacking. In the present fly it is unusually long and powerfully constructed.

TIPULA (VESTIPLEX) EXCISOIDES Alexander.

Tipula (Vestiplex) excisoides ALEXANDER, Philip. Journ. Sci. 52 (1933) 398-399.

Described from various stations in Kamchatka. One male, Lake Yôda, Paramushir Island, northern Kurile Islands, Japan, July 14, 1934 (*D. Miyadi*), in the Otsu Hydrobiological Station Laboratory, Otsu, Japan.

³ Insec. Inscit. Menst. 5 (1917) 21-23.

⁴ Loc. cit.

TIPULA (ARCTOTIPULA) MIYADII sp. nov. Plate 1, fig. 3; Plate 2, fig. 32.

General coloration (in alcoholic specimens) black, probably pruinose in fresh specimens; antennæ black throughout; wings tinged with brownish, the long-oval stigma brownish black, very conspicuous; cell M_1 petiolate; abdomen uniformly dark in male, the intermediate segments in female very narrowly ringed caudally with pale; male hypopygium with the lateral lobes of tergite truncate, the median notch deep, U-shaped; apical beak of inner dististyle very slender.

Male.—Length, about 15 millimeters; wing, 15.5; antenna, about 3.5.

Female.—Length, about 20 millimeters; wing, 20.

Described from alcoholic specimens.

Frontal prolongation of head and palpi black, the incisures of the latter restrictedly pale; nasus very long and conspicuous. Antennæ black throughout, short in both sexes; flagellar segments short-cylindrical, without well-defined basal enlargements; verticils longer than the segments. Head gray, with long conspicuous setæ.

Thorax (in alcohol) uniformly dark, in dry specimens presumably pruinose; it cannot be stated that the præscutum is or is not striped. Halteres dusky, the knobs slightly more darkened. Legs with coxæ and trochanters black, pruinose; femora obscure yellow basally, the outer third or so darker, the tips black; tibiæ and basitarsi brown basally, the tips black; remainder of tarsi black. Wings (Plate 1, fig. 3) tinged with brownish, the long-oval stigma brownish black; restricted obliterative areas before and beyond stigma and across base of cell 1st M_2 ; very vague to scarcely indicated darker seams along cord and on veins beyond cord; veins brownish black to black. Venation: Sc_1 represented by a weak spur some distance before end of Sc_2 ; petiole of cell M_1 subequal to m ; distal section of Cu_1 curved rather strongly to the anal angle of wing.

Abdomen uniformly dark in male, in female with the extreme caudal borders of the intermediate segments paler; hypopygium dark. Male hypopygium with the tergite (Plate 2, fig. 32, 9t) slightly longer than broad, the caudal margin with a deep U-shaped median notch; lateral lobes truncate; no lobule at base of median incision. Outer dististyle, *od*, flattened, more or less shaped like a human sole, the outer end narrowed. Inner dististyle, *id*, with the spine at near midlength of outer face powerful, acute; apex of beak of style slender, the tip narrowly obtuse.

Habitat.—Japan (Kurile Islands).

Holotype, alcoholic male, Lake Yôda, Paramushir Island, July 14, 1934 (*D. Miyadi*). Allotopotype, alcoholic female, in collection of the Otsu Hydrobiological Station, Otsu, Japan.

I take great pleasure in naming this distinct species of *Arctotipula* in honor of the collector, Dr. D. Miyadi, to whom I am indebted for the opportunity of examining a small series of crane flies from the northern Kurile Islands. The nearest allies are *Tipula* (*Arctotipula*) *salicetorum* Siebke (*nigricornis* Zetterstedt, preoccupied; *zetterstedti* Strobl, renaming of last) of northern Europe; *T. (A.) alascensis* Alexander (Pribilof Islands, Alaska), and *T. (A.) hirtitergata* Alexander (northeastern Asia). The first-named species has a very different hypopygium.⁵ The two last-named species differ in the general coloration of the wings and legs, and, especially, in the structure of the male hypopygium, notably the broadly expanded apex or beak of the inner dististyle.

TIPULA (SCHUMMELIA) STIPATA sp. nov. Plate 1, fig. 4; Plate 2, fig. 33.

Belongs to the *continuata* group; allied to *bidenticulata*; male hypopygium with the caudal end of the inner dististyle produced backward into a broad compressed blade, its caudal end weakly emarginate.

Male.—Length, about 12 millimeters; wing, 13.

Female.—Length, about 11 to 12 millimeters; wing, 13 to 14.

Frontal prolongation of head yellow above, dark brown on sides; palpi black. Antennæ with the scape and pedicel yellow; basal segments of flagellum weakly bicolorous, the basal enlargements brownish black, the remainder of each segment somewhat paler, yellowish brown. In female the flagellum is conspicuously bicolorous, dark brown and light yellow. Head yellow, the posterior vertex more cinnamon brown on either side of the broad yellow median line.

Pronotum yellow medially, variegated with dark brown on sides. Mesonotal præscutum yellow, with three conspicuous brown stripes, the median one very narrowly split by a vaguely paler line; lateral borders of sclerite and posterior interspaces more or less suffused with dusky; median area of mesonotum behind the suture broadly yellow, the lateral portions dark brown, including the scutal lobes, parascutella and sides of medio-

⁵Lundström, C., *Acta Soc. Fauna Flora Fennica* 29 No. 2 (1907) pl. 1, fig. 10; Lackschewitz, P., *Norsk Entomologisk Tidskrift* 3 (1933) 258, pl. 2, fig. 6.

tergite. Pleura yellow, more or less variegated by brown on anepisternum, ventral sternopleurite and meron; cervical region and propleura conspicuously darkened. Halteres with stem obscure yellow, the base of knob infuscated, the apex broadly yellow. Legs with the coxæ testaceous-yellow, the posterior pair in cases a little darkened at bases; trochanters yellow; femora yellow, the tips rather narrowly but conspicuously blackened; tibiæ yellowish brown, the tips narrowly darker; tarsi passing through brown to brownish black. Wings (Plate 1, fig. 4) subhyaline; cell Sc infumed, cell C yellow; stigma dark brown, conspicuous; broad brown seams on m-cu and distal section of vein Cu_1 ; weak darkened clouds in outer radial field and outer discal portion of cell 1st A; more yellowish areas before and beyond stigma and across cell 1st M_2 ; veins brown. Venation: R_{1+2} pale, with macrotrichia on basal half or more; cell 1st M_2 small; basal sections of M_{1+2} and M_3 so pale as to be virtually obliterated; petiole of cell M_1 more than twice m, usually several times this length.

Abdominal segments yellow basally, the outer ends broadly brown to dark brown, in cases more uniformly darkened. Male hypopygium with the caudal margin of tergite (Plate 2, fig. 33, 9t), as viewed from above, very gently emarginate; on ventral surface with a low, obtuse, median, blackened lobe and longer, subacute, spinous, lateral points, invisible from above. Outer dististyle long, gradually narrowed outwardly. Inner dististyle, *id*, compact, with the posterior or caudal end produced backward into a broad, compressed blade that bears numerous setæ; this extension is somewhat as in *bidenticulata* and *nipponensis*, yet quite distinct in conformation.

Habitat.—Japan (Saghalien).

Holotype, male, Takinosawa, July 26, 1922 (*Esaki*). Allotype, female, Nodosam, July 30, 1922 (*Esaki*). Paratype, female, Konuma, July 21, 1922 (*Esaki*).

I had earlier misdetermined this material as being *Tipula nipponensis* Alexander.⁶ The nearest ally is *Tipula* (*Schumelia*) *bidenticulata* Alexander, which differs especially in the structure of the inner dististyle of the hypopygium and in the wing pattern and venation, as the larger cell 1st M_2 .

⁶ Philip. Journ. Sci. 24 (1924) 604.

TIPULA (OREOMYZA) MALAISEI Alexander.

Tipula malaisei ALEXANDER, Arkiv för Zoologi, Band 19 A, No. 9 (1927) 6-8, fig. 3.

Described from Petropavlovsk, Kamchatka, July 13 and 14, 1922 (*R. Malaise*). Two females, Lake Sue-Bettobu 26, Shumshir Island, northern Kurile Islands, Japan, July 22, 1934 (*Miyadi*); Otsu Hydrobiological Laboratory, Otsu, Japan.

TIPULA (LUNATIPULA) JUSTA sp. nov. Plate 1, fig. 5; Plate 2, fig. 34.

Belongs to the *variipetiolearis* group; size large (wing over 20 millimeters); mesonotal præscutum with a clear gray median stripe that is narrowly bordered by dark brown; wings brown, striped longitudinally with white; male hypopygium with the inner dististyle gradually diverging outwardly; eighth sternite with the median lobe long-triangular in outline.

Male.—Length, 17 to 19 millimeters; wing, 22 to 24.5.

Frontal prolongation of head relatively long, dark reddish brown; nasus lacking; palpi brown, the last segment black. Antennæ with scape and pedicel fulvous; flagellum dark brown, the basal enlargement slightly developed; longest verticils exceeding the segments. Head gray.

Pronotum brown, darker laterally. Mesonotal præscutum with the median stripe clear gray, bordered laterally by dark brown, the margins becoming narrower and finally obsolete behind; posterior interspaces slightly clearer ashen-gray than the median stripe; lateral stripes, and humeral and lateral borders of sclerite, more infumed, the extreme lateral margin still darker; posterior sclerites of mesonotum dull gray, the mediotergite with indications of a capillary darker vitta. Pleura chiefly gray, variegated by slightly more brownish areas; dorso-pleural membrane infuscated, more strongly so behind. Halteres dusky, the knobs dark brown. Legs with the coxæ and trochanters brownish gray; femora brownish yellow, the tips narrowly blackened; tibiæ brownish yellow, the tips more narrowly infuscated; tarsi pale basally, passing into black. Wings (Plate 1, fig. 5) with a strong brown tinge, striped longitudinally with whitish, the latter including streaks in the anal cells; outer end of cell R and a broad continuous line from cell 1st M_2 to the wing tip, involving portions of cells R_5 , M_1 , and 2d M_2 ; restricted obliterative areas before and beyond stigma; base of

cell M_3 pale, sending an extension to margin along vein M_4 ; restricted darker brown areas include the stigma, tip of Sc_2 , origin of Rs and cord; veins dark, paler in the more brownish yellow costal region. Venation: Cell Sc_2 relatively long, due to the length of the free tip of Sc_2 ; cell M_1 petiolate, this subequal to or longer than m .

Abdominal tergites obscure yellow, narrowly trivittate with dark brown, the stripes continuous or nearly so; lateral borders of tergites more grayish; hypopygium more uniformly brown. Male hypopygium with the tergite (Plate 2, fig. 34, 9t) having the median point acute, subtended by a few setæ. Inner dististyle, *id*, not parallel-sided, as in *variipetiolaris*, gradually diverging outwardly. Eighth sternite, *8s*, with median lobe long-triangular in outline, not expanded distally, as in *minensis*.

Habitat.—China (Szechwan).

Holotype, male, Wei Chow, 65 miles northwest of Chengtu, altitude 9,000 to 12,500 feet, August 15, 1933 (Graham). Paratopotypes, 2 males, altitude 15,200 feet, August 14, 1933 (Graham).

The nearest relatives of the present species are *Tipula* (*Lunatipula*) *minensis* Alexander and *T. (L.) variipetiolaris* Alexander, which differ especially in the hypopygial structure, as discussed above. In stature the present fly agrees more nearly with *minensis*. The length of the petiole of cell M_1 does not show the variation evidenced in *variipetiolaris*.

NEPHROTOMA INTEGRATA sp. nov. Plate 1, fig. 6; Plate 3, fig. 35.

Mesonotal præscutum obscure reddish yellow, with three polished brownish black stripes that are not bordered by a different color; mediotergite dark, with a median yellow triangle; antennæ elongate, flagellum black; wings brownish yellow, the wing tip broadly darkened; abdomen yellow, the tergites with broad, brownish black triangles; eighth sternite darkened; male hypopygium with the median area of tergite entire; basistyle with a blackened bifid lobe; inner dististyle with a high glabrous vertical crest; ninth sternite with a median pubescent lobe.

Male.—Length, about 12 to 13 millimeters; wing, 10 to 12.5; antenna, about 5.8 to 6.8.

Female.—Length, about 15 millimeters; wing, 12.

Frontal prolongation of head yellow, the outer half of dorsal surface, together with the nasus, more or less infuscated; palpi brownish black. Antennæ (male) relatively elongate, as shown by the measurements; scape obscure yellow; pedicel and basal segment of flagellum brownish yellow; remainder of flagellum

black, the elongate segments rather strongly incised, the verticils shorter than the segments. Head orange; a small, dark, orbital spot at narrowest point of anterior vertex; occipital brand very small, undifferentiated from the ground.

Pronotum obscure yellow medially, dark brown on sides. Anterior lateral pretergites pale yellow. Mesonotal præscutum obscure reddish yellow, with three polished brownish black to black stripes, the median one with a more reddish median line; stripes not margined with another color; scutum yellow medially, the lobes solidly brownish black; scutellum obscure brownish yellow, the parascutella dark brown; mediotergite dark brown with a central yellow triangle, the point directed backward. Pleura very pale yellow, variegated with reddish brown on ventral anepisternum, ventral sternopleurite and meron, and dorsal portion of pleurotergite. Halteres with stem brownish yellow, the base of knob dark brown, the apex obscure yellow. Legs with fore coxæ darkened on anterior faces, remainder of coxæ and all trochanters yellow; femora yellowish brown, the bases clearer yellow, the extreme tips blackened; tibiæ pale brown, the tips narrowly darkened; tarsi brownish black to black. Wings (Plate 1, fig. 6) with a strong brownish yellow tinge, cells C and Sc somewhat darker; stigma dark brown; brown seams along cord and outer end of cell 1st M_2 ; wing tip broadly brown, the color extending basad almost to level of outer end of cell 1st M_2 , especially along the veins; veins brown. Stigmal trichia variable, from eight to twenty-five in number, all in cell R_1 . Venation: Cell M_1 sessile; m-cu at or close to fork of M_4 , the latter shortly before M_3 .

Abdominal tergites yellow, the segments with broad, posterior, brownish black triangles, on the outer segments becoming more transverse, bandlike; lateral borders of tergites with a darkened spot at near midlength; sternites with posterior margins more narrowly darkened, the eighth sternite chiefly blackened; hypopygium reddish yellow. Male hypopygium with the lateral horns of tergite (Plate 3, fig. 35, 9*t*) relatively broad; median tergal area entire, transverse, with weak spines and setæ on lateral portions only. Basistyle with a blackened lobe that is more or less bifid at tip. Outer dististyle, *od*, relatively narrow, extended into a long slender point. Inner dististyle, *id*, with a high, vertical, glabrous crest; beak slender. Ninth sternite with a median fingerlike lobe, directed ventrad, the lobe with abundant delicate setulæ. Eighth sternite with a shallow median notch, the adjacent portions of the lobes with nu-

merous long setæ that are directed caudad and mesad. Penis stout.

Habitat.—Formosa.

Holotype, male, Rokki, altitude 1,000 feet, May 16, 1934 (*Gressitt*). Allotopotype, female, pinned with the type. Paratopotypes, 2 males, 1 female.

The coloration of the posterior sclerites of the mesonotum indicates that the present fly is allied to species of the *palloris* group, but the coloration of the præscutum and structure of the male hypopygium are very different from all described members of that group. The blackened bifid lobe on the basistyle of the male hypopygium is very similar to that found in *Nephrotoma biarmigera* Alexander (eastern China), which is otherwise an entirely different fly.

NEPHROTOMA ESAKII Alexander. Plate 1, fig. 7; Plate 3, fig. 36.

Nephrotoma esakii ALEXANDER, Philip. Journ. Sci. 24 (1924) 596-597.

Described from Kamiotoineppu, Hokkaido, Japan, August 25, 1922 (*Esaki*). Additional specimens: Sapporo, Hokkaido, July 23, 1924 (*M. Hori*); 1 male, Yumoto, Shimotsuke, Honshiu, Japan, altitude 5,000 feet, August 6, 1934 (*Issiki*).

The venation is shown (Plate 1, fig. 7). The male hypopygium is somewhat peculiar and may be described as follows: Ninth tergite (Plate 3, fig. 36, 9t) deeply and acutely notched medially, the lateral lobes obtuse. Outer dististyle, *od*, entirely blackened, elongate, gently arcuate, more or less boomerang-shaped. Inner dististyle, *id*, with the beak stout; crest erect. Membrane between the eighth and ninth sternites with a conspicuous depressed lobe shaped about as shown in the figure, 9s. Eighth sternite with the median area of posterior border without setæ, the remainder of sclerite with long, conspicuous, black setæ.

NEPHROTOMA SERRISTYLA sp. nov. Plate 1, fig. 8; Plate 3, fig. 37.

General coloration of mesonotal præscutum yellow, with three polished, reddish ferruginous stripes; lateral ends of suture broadly and conspicuously black; antennæ (male) relatively long, the basal flagellar segments bicolorous; head orange-yellow, without occipital brand; pronotum entirely light yellow; wings weakly tinged with brown, the stigma slightly darker brown; male hypopygium with the inner dististyle bearing a conspicuous serrate crest, the apical beak slender, black; mem-

brane between eighth and ninth sternites with a prow-shaped orange lobe.

Male.—Length, 10 to 11 millimeters; wing, 10.5 to 11.

Female.—Length, 13 to 14 millimeters; wing, 12 to 13.

Frontal prolongation of head, including nasus, yellow; palpi obscure yellow throughout. Antennæ (male) relatively long and stout, if bent backward extending approximately to base of abdomen; basal three segments yellow, the succeeding three or four segments bicolorous, dark brown basally, the remainder yellowish brown; outer flagellar segments uniformly brownish black; flagellar segments rather strongly incised. In female the short antennæ are less evidently bicolorous. Head orange-yellow, without evident occipital brand.

Pronotum entirely light yellow. Mesonotal præscutum yellow, with three, polished, reddish ferruginous stripes that are not bordered or variegated by other colors, except that in certain specimens the median stripe is somewhat paler in its central portion; lateral end of suture and lateral borders of scutal lobes intensely black; scutum yellow medially, the lobes extensively reddish ferruginous; scutellum testaceous-brown, the parascutella yellow; mediotergite uniformly yellow. Pleura yellow, the ventral anepisternum and sternopleurite, and dorsal and posterior pleurotergite slightly more reddish. Halteres dusky, the knobs faintly obscure yellow. Legs with the coxæ and trochanters yellow; femora and tibiæ yellow, the tips very narrowly and inconspicuously darkened; tarsi passing through brown to black. Wings (Plate 1, fig. 8) with a weak brown tinge; stigma oval, slightly darker brown; veins brown. A few scattered stigmal trichia in cell R_1 . Venation: Sc_2 ending a short distance beyond origin of Rs , Sc_1 weakly preserved; cell M_1 short-petiolate to sessile; $m-cu$ close to fork of M_4 , the latter some distance before fork of M_3 .

Abdomen orange-yellow, the tergites very weakly darkened before suture; in cases, the subterminal segments darkened; hypopygium yellow. Male hypopygium with the lateral horns of tergite (Plate 3, fig. 37, 9*t*) acute, unarmed with blackened spines except at extreme base. Outer dististyle, *od*, pale, the apical third attenuate. Inner dististyle, *id*, with the apical beak slender, intensely blackened; dorsal crest broad and extensive, the margin produced into several pale points. Membrane between eighth and ninth sternites with a small prow-shaped lobe, orange in color.

Habitat.—China, eastern Siberia.

Holotype, male, Chungking, Szechwan, China, altitude 1,000 to 2,000 feet, May 6 to 27, 1930 (*Graham*). Allotopotype, female. Paratopotypes, 6 males and females; paratype, 1 male, Kotikowo Station of the Ussuri Railway, Ussuri Province, eastern Siberia, July 26, 1927 (*Stackelberg*).

Nephrotoma serristyla is most closely allied to *N. parvirostra* Alexander, differing most conspicuously in the coloration of the thorax and antennæ. The serrate dorsal crest of the inner dististyle occurs in several other species of the genus, including besides *parvirostra*, the European *N. scurra* (Meigen).

NEPHROTOMA PROFUNDA sp. nov. Plate 1, fig. 9; Plate 3, fig. 38.

General coloration of thorax polished yellow, the præscutum with three reddish brown stripes; antennæ short, the flagellar segments with very long verticils; wings with stigma dark brown; abdominal tergites yellow, trivittate with black; male hypopygium with the eighth sternite long, profoundly incised, the margins of the notch fringed with long yellow setæ.

Male.—Length, about 12.5 to 15 millimeters; wing, 11.5 to 14.

Female.—Length, about 16 to 18 millimeters; wing, 13 to 14.

Frontal prolongation of head varying from yellow to brown; palpi with basal segments dark brown, the outer two segments paler. Antennæ unusually short, in male if bent backward not attaining the wing root; basal three segments obscure yellow, the remainder passing into black; flagellar segments very weakly incised, the basal enlargements only feebly developed; verticils very long, exceeding the segments. Head yellow, without clearly defined occipital brand.

Pronotum darkened medially, yellow on sides. Mesonotal præscutum polished yellow, with three reddish brown stripes that are not bordered by any other color; lateral stripes straight; scutum yellow medially, the lobes extensively reddish brown; scutellum testaceous-yellow; mediotergite light yellow, with a median brown line, narrowed behind and not attaining the posterior margin. Pleura yellow, with more reddish areas on anepisternum, ventral sternopleurite, and pleurotergite. Halteres dusky, the base of stem restrictedly paler. Legs with the coxæ and trochanters yellow; femora and tibiæ yellow, the tips not or scarcely darkened; tarsi passing into brown. Wings (Plate 1, fig. 9) with the ground color yellow, cells C and Sc more saturated; stigma dark brown, conspicuous; restricted dark seams

on anterior cord and wing tip; veins brown, more yellowish in prearcular and costal portions of wing. Venation: Sc_2 extending to a short distance beyond origin of Rs , Sc_1 weakly preserved; cell M_1 variable, from sessile to having a petiole longer than m ; $m-cu$ at fork of M_4 or shortly beyond base of latter.

Abdominal tergites yellow, trivittate with black, the median stripe broader; lateral stripes slightly constricted and interrupted on basal ring; median region of sternites weakly darkened; eighth segment chiefly blackened; hypopygium chiefly reddish brown. Male hypopygium with the tergite (Plate 3, fig. 38, 9t) having the median notch narrow. Outer dististyle, *od*, long-attenuate. Inner dististyle, *id*, with the apical beak slender; dorsal crest pale, irregularly toothed. Eighth sternite, $8s$, long, with a very deep and acute median incision that extends cephalad to about the basal third of the sclerite; margin of incision with long, conspicuous, yellow setæ. Gonapophyses, *g*, subequal in length to ædeagus, appearing as smooth, weakly curved blades, their tips acute.

Habitat.—China (Szechwan).

Holotype, male, Chengtu, altitude 1,700 feet, May 10 to 14, 1933 (*Graham*). Allotopotype, female. Paratopotypes, numerous males and females.

The nearest ally is *Nephrotoma minuticornis* Alexander (Japan), which differs most conspicuously in the pale stigma of the wings and in the structure of the male hypopygium, especially of the eighth sternite.

NEPHROTOMA BIFASCIGERA sp. nov. Plate 1, fig. 10; Plate 3, figs. 39 and 40.

General coloration yellow, the præscutum with three black stripes, the lateral pair outcurved; antennal flagellum black; occipital brand very large; pronotum yellow medially, darkened on sides; scutellum with a linear black median dash; mediotergite with an inverted T-shaped black area; pleura spotted with black; femora yellow, the tips narrowly blackened; wings subhyaline; stigma dark brown; a narrow dark seam on anterior cord; abdominal tergites with a broad, median black stripe, the lateral borders of the segments grayish brown; a subterminal black ring; male hypopygium with the lateral horns of tergite crowned with black spines; eighth sternite broad, the lateral angles with tufts of black setæ, the median area filled with pale membrane; gonapophyses yellow, broadly flattened, the tips bispinous.

Male.—Length, about 11 to 11.5 millimeters; wing, 10 to 10.5.

Frontal prolongation of head light yellow, the dorsal surface with an oval or U-shaped dark brown mark, the arms directed caudad; nasus dark; palpi black, the outer segment a little brighter. Antennæ with scape reddish yellow; pedicel and base of first flagellar segment a little more brownish yellow; remainder of flagellum black; segments of moderate length and only feebly incised; longest verticils subequal to the segments. Front light sulphur yellow, the posterior portions more orange; occipital brand very large, subcircular or oval in outline, sending a narrow point cephalad almost to summit of vertical tubercle; a pale brown to darker spot near orbits behind antennal fossæ.

Pronotum light yellow, weakly infuscated on sides. Mesonotal præscutum yellow, with three subnitidous black stripes that are very narrowly bordered by a more opaque black; median stripe narrowed at posterior end and reaching the suture; lateral stripes with a paler brown spot at anterior end, giving an out-curved appearance; a narrow brown line on posterior pretergites before the suture; scutum light yellow, each lobe with two confluent black areas, leaving the median area and lateral borders broadly pale; scutellum testaceous-yellow, with a narrow, dark brown, median vitta; parascutella obscure yellow; mediotergite sulphur yellow, with an inverted T-shaped black area, the stem a little widened at anterior end. Pleura yellow, variegated with brownish black, including areas on ventral and posterior anepisternum, ventral sternopleurite, and extreme ventral meron; less-evident brown areas on dorsal and ventral pleurotergite and a small dark spot on the meropleurite. Halteres yellow, the base of knob weakly darkened. Legs with the coxæ yellow, the anterior pair slightly darker basally; trochanters yellow; femora yellow, the tips narrowly but conspicuously blackened, the amount subequal on all legs; tibiæ yellow, the tips narrowly infuscated; tarsi black. Wings (Plate 1, fig. 10) subhyaline, cells C and Sc concolorous; stigma oval, dark brown; a very narrow to scarcely evident dark seam on anterior cord; veins brown. A group of from ten to fifteen stigmal trichia in cell R_1 . Venation: Sc_2 ending shortly beyond origin of Rs , Sc_1 preserved; cell M_1 subsessile to sessile; m-cu at or shortly before fork of M_4 .

Abdominal tergites orange, with a broken, brownish black, median stripe, interrupted at posterior borders, widest and most conspicuous on the intermediate segments, becoming narrower and subobsolete on the fifth and sixth segments; lateral borders

of tergites more grayish brown; segments seven to nine chiefly black, the styli yellow; sternites yellow, with a median brownish black line, in cases more extensive, leaving the posterior borders pale. Male hypopygium with the lateral arms of tergite (Plate 3, fig. 39, 9t) stout, crowned with numerous black spines; median incision narrow; a conspicuous U-shaped pale area on disk of tergite. Outer dististyle (Plate 3, fig. 39, od) moderately attenuated; setæ and punctures pale and inconspicuous. Inner dististyle, *id*, with a long, low, dorsal crest; apical beak slender. Eighth sternite (Plate 3, fig. 40, 8s) broad, each lateral angle a little produced and bearing a tuft of long setæ, the entire median area between these lobes filled with white membrane. Gonapophyses (Plate 3, fig. 40, g) appearing as broadly flattened, bispinous, yellow plates.

Habitat.—Eastern Siberia.

Holotype, male, Beitonovo, Amur River, Amur Province, May 28, 1915 (*Popoff*). Paratopotype, one broken male; paratype, 1 male, Osernaja, mouth of Amur River, May 31, 1910 (*W. Soldatov*); type in the Russian Academy of Sciences, Leningrad.

This fly bears a certain resemblance to *Nephrotoma virgata* (Coquillett) and traces to this species by means of keys to the local fauna. The male hypopygium is very distinctive.

NEPHROTOMA SUBLAMELLATA sp. nov. Plate 1, fig. 11; Plate 4, fig. 41.

Nephrotoma lamellata Riedel, variety; ALEXANDER, Philip. Journ. Sci. 24 (1924) 599.

Mesonotal præscutum with three feebly shining black stripes; scutellum brownish black; mediotergite yellow, with a median inverted T-shaped black area; pleura yellow, with conspicuous black markings; femora and tibiæ yellow, the tips very narrowly and insensibly darkened; wings tinged with yellow; stigma oval, dark brown, with numerous trichia; wing tip and a seam on anterior cord darkened; male hypopygium with the lateral angles of tergite produced into flattened, inwardly directed plates; gonapophyses appearing as flattened yellow blades, the outer edge and apex with microscopic serrations.

Male.—Length, about 14 millimeters; wing, 14.

Frontal prolongation of head light yellow, the dorsal portion on distal half, including nasus, blackened; palpi yellowish. Antennæ (male) of moderate length, if bent backward extending to the wing root or just beyond; scape and pedicel orange; first flagellar segment brown; remainder of flagellum black, the segments rather strongly incised; verticils shorter than the segments. Head orange-yellow, the occipital brand large, dark

brown, its anterior margin not clearly defined; a weak infuscation on narrowest part of vertex bordering the eye.

Pronotum broadly light yellow medially, blackened on sides. Mesonotal præscutum light yellow, with three, feebly shining, black stripes that are very narrowly and insensibly bordered by darker; a large velvety black area opposite anterior end of lateral stripes; scutum yellow medially, each lobe with a large, feebly shining, black area, crossing the lateral portions of suture; scutellum brownish black, the parascutella and adjoining portions of scutal lobes light yellow; mediotergite yellow, with a median brown stripe, behind widely expanded and more blackened; scutellum and mediotergite with inconspicuous pale setæ. Pleura light yellow, conspicuously variegated with black areas on the ventral anepisternum, ventral sternopleurite, ventral meron and dorsal pleurotergite. Halteres chiefly pale reddish, the base of knob weakly suffused. Legs with the fore coxæ yellow, blackened basally, remaining coxæ and all trochanters yellow; femora and tibiæ yellow, the tips narrowly and weakly darkened; tarsi brownish black. Wings (Plate 1, fig. 11) tinged with yellow, cells C and Sc somewhat more saturated yellow; stigma oval, dark brown; wing tip narrowly but conspicuously darkened; a brown seam on anterior cord; veins brown, Sc more yellow. About fifty stigmal trichia in cell R₁. Venation: Sc₂ ending opposite to just beyond origin of Rs, Sc₁ represented by a short spur; cell M, very short-petiolate to barely sessile; m-cu at fork of M₂, the latter a short distance before M₃.

Abdominal tergites yellow, with three more or less distinct stripes that are somewhat obscured by abundant yellow setæ over the surface of the segments; subterminal segments blackened; hypopygium obscure yellow. Male hypopygium with the ninth tergite (Plate 4, fig. 41, 9t) with powerful, flattened, lateral blades, directed strongly mesad, with additional submedian flattened plates that bear the usual blackened teeth and setæ. Outer dististyle, *od*, unusually narrow, the tip attenuate. Inner dististyle, *id*, with the apical beak pale; no dorsal crest. Ninth sternite with a conspicuous protuberant horseshoe-shaped area. Eighth sternite with the caudal margin scarcely emarginate, unarmed. Gonapophyses, *g*, appearing as large, geniculate, flattened, yellow blades, the outer edge and apex weakly serrate.

Habitat.—Japan (Saghalien).

Holotype, male, Shimizu, July 27, 1922 (*Esaki*); in author's collection.

The nearest allies of the present species are *Nephrotoma lamellata* (Riedel) and *N. ozenumensis* Alexander, which differ in several details of coloration and structure of the male hypopygium. The yellow legs are rather distinctive in this particular group of species.

NEPHROTOMA CHOSENSIS sp. nov. Plate 1, fig. 12; Plate 4, fig. 42.

General coloration yellow, conspicuously patterned with black; mesonotal præscutum with three black stripes, the lateral pair outcurved to margin at anterior end; a median dark line on mediotergite; pleura conspicuously patterned with black; femoral tips narrowly blackened; wings rather strongly tinged with brownish yellow; stigma oval, dark brown; abdominal tergites with three interrupted black stripes; male hypopygium with the inner dististyle unprovided with dorsal crest; eighth sternite without lobes or setal modifications; gonapophyses appearing as elongate yellow blades.

Male.—Length, about 13 millimeters; wing, 12; antenna, 4.2.

Frontal prolongation of head yellow, the dorsal surface, including nasus, black; palpi brown. Antennæ of moderate length, if bent backward extending about to wing root; scape light brown; pedicel a little darker; flagellum black; flagellar segments rather strongly incised, the basal enlargement conspicuous; longest verticils subequal to the segments. Head orange, paling to yellow behind; occipital brand large, brownish black, sending an anterior prolongation to summit of vertical tubercle.

Pronotum yellow medially, black on sides. Mesonotal præscutum dirty yellow, with three polished black stripes that are not bordered by a different color; lateral stripes bent outward to margin at outer ends; a black area on lateral portion of præscutum before suture; scutum yellow, each lobe with two confluent black areas, not connected with the lateral præscutal stripes; scutellum light brown, parascutella yellow; mediotergite testaceous-yellow, with a median black stripe that narrows behind, the posterior borders of sclerite less heavily darkened. Pleura yellow, variegated with black on anepisternum, ventral sternopleurite, ventral meron, dorsocephalic portion of pteropleurite, and on pleurotergite. Halteres obscure yellow, the base of knob infuscated, the apex yellow. Legs with the coxæ yellow, blackened basally, most broadly so on forelegs, narrowest on middle coxæ; trochanters yellow; fore femora yellow basally, the outer half darkened, with a vague, obscure yellow, subterminal ring before the narrow more-blackened tips;

middle femora yellow, the tips narrowly black; tibiae yellow, passing into brownish yellow, the tips narrowly darkened; tarsi dark brown or brownish black. Wings (Plate 1, fig. 12) rather strongly tinged with brownish yellow, cell Sc somewhat darker than cell C; stigma oval, dark brown, narrowly bordered by paler brown; a seam on anterior cord and wing tip narrowly infuscated; veins brownish black. Stigmal trichia reduced in number to four or five. Venation: Sc₂ ending just beyond origin of Rs, Sc₁ opposite this origin; cell M₁ short-petiolate; m-cu at fork of M.

Abdominal tergites with three broken black stripes, the median row interrupted at both base and apex of each segment; lateral stripes more complete, interrupted at posterior portions of segments; sternites yellow, diffusely infuscated medially; subterminal segments and hypopygium more extensively darkened. Male hypopygium with the lateral lobes of tergite (Plate 4, fig. 42, 9t) broadly truncated, separated by a deep U-shaped median notch, the margin with abundant blackened spicules, the dorsal surface with more scattered points; from ventral surface of lateral lobes on outer portion a slender spine bearing one or two blackened spicules near base. Outer dististyle, *od*, relatively small, the tip little produced, the length about two and one-half times the width. Inner dististyle, *id*, without a dorsal crest; apical beak relatively slender. Eighth sternite with caudal margin very gently emarginate, without lobes or specially modified setae. Gonapophyses, *g*, appearing as flattened elongate blades, a little constricted beyond midlength, the tips oval, spatulate.

Habitat.—Korea.

Holotype, male, Kongo San, October 17, 1933 (*Machida*).

Most generally similar to *Nephrotoma contrasta* Alexander and *N. sublamellata* sp. nov., differing most evidently in the details of structure of the male hypopygium.

NEPHROTOMA MARTYNOVI sp. nov. Plate 1, fig. 13; Plate 4, fig. 43.

Size large; general coloration yellow, the præscutum with three black stripes, the lateral pair straight or with an isolated brown spot opposite their anterior end; antennal flagellum black, the segments rather strongly incised; occipital brand small; pronotum, scutellum, and mediotergite yellow; pleura yellow, variegated by more reddish areas; fore femora broadly blackened, the remaining femora narrowly so; wings yellow, more saturated in costal portion; stigma dark brown, with few trichia; narrow dark seams on cord and at wing tip; abdomen

yellow, indistinctly trivittate with darker; subterminal segments black; hypopygium pale at apex; lateral horns of ninth tergite of male hypopygium slender, glabrous; eighth sternite unarmed; gonapophyses appearing as flattened blades.

Male.—Length, 15 to 16 millimeters; wing, 14 to 15.

Female.—Length, 22 to 23 millimeters; wing, 15 to 16.

Frontal prolongation of head obscure yellow, darker dorsally, the nasus black; palpi brown. Antennæ with scape and pedicel orange; flagellum black; flagellar segments rather strongly incised; verticils a little shorter than the segments. Head orange; occipital brand small, dark brown, triangular in outline; vertical tubercle entire; a small brown orbital spot on either side of vertical tubercle.

Pronotum and propleura entirely yellow. Mesonotal præscutum yellow, with three black stripes that are very insensibly margined with more opaque black; lateral stripes straight or with a small isolated paler brown spot opposite their anterior ends; scutum yellow, each lobe with two confluent black areas, crossing the suture and becoming confluent with the lateral præscutal stripes; scutellum testaceous-yellow, the parascutella bright yellow; mediotergite yellow, the posterior portion slightly more orange though scarcely darkened; the type female shows a median linear dark dash on mediotergite. Pleura yellow, variegated by more reddish areas on ventral anepisternum, ventral sternopleurite, ventral meron and ventral pleurotergite. Halteres yellow, the base of knob weakly darkened, the apex clear light yellow. Legs with the coxæ and trochanters yellow; femora yellow, the tips blackened, very broadly so on the forelegs where more than the outer half is included; narrower on the middle and posterior legs where only the outer eighth or tenth is darkened; tibiæ obscure yellow, the tips narrowly darkened; tarsi black. Wings (Plate 1, fig. 13) with a yellow tinge, the base and cells C and Sc clearer yellow; stigma oval, dark brown; wing tip narrowly infumed; cord, including the distal section of vein Cu_1 , seamed with brown; veins beyond cord more narrowly seamed with darker; veins dark brown, the prearcular and costal veins more yellow. Stigmal trichia reduced in number to five or six. Venation: Sc_2 ending opposite or just beyond origin of Rs , Sc_1 barely indicated; cell M_1 sessile; m-cu just beyond origin of vein M_4 .

Abdomen obscure yellow, the basal segments scarcely marked or with vague indications of darker stripes only; in female, with three darker stripes; male with subterminal segments

intensely black, the styli yellow; basal sternites unmarked. Male hypopygium with the ninth tergite (Plate 4, fig. 43, 9t) having the lateral horns slender and entirely glabrous; intermediate lobes obtuse, with numerous black spines and setæ, the apex further produced into a triangular pale point. Outer dististyle, *od*, pale, only moderately attenuated at tip, the cephalic margin a little attenuate. Inner dististyle, *id*, without dorsal crest. Eighth sternite with the caudal margin virtually entire or with a barely indicated median emargination, without lobes; setæ of posterior border longer but not modified into brushes. Gonapophyses, *g*, elongate, compressed-flattened, in profile appearing like a duck's head, the tip obtuse.

Habitat.—Eastern Siberia, Manchoukuo.

Holotype, male, Silinche Station, East Chinese Railway, Manchoukuo, July 10, 1911 (*Spechilov*). Allotype, female, Ulunga, Amur Province, eastern Siberia, June 24, 1910 (*Mishin*). Paratypes, a broken female, Habarovsk district, Samnjur River, Amur Province, July 9 to 11, 1910 (*Czerski*); a broken male, Bikin River, Ussuri, July 9, 1927 (*Martynov*); a broken male, Maiche region, near Shkotovo, June 4, 1927 (*Martynov*).

The species is named in honor of Dr. A. B. Martynov, distinguished student of recent and fossil insects. The nearest relatives are species such as *Nephrotoma geminata* Alexander and *N. subpallida* Alexander, which are readily told by the small size, different coloration of the wings, and the structure of the male hypopygium. The unmarked prothorax and mediotergite separate the species from other large, somewhat similar species in the western Palæarctic region, such as *N. quadrifaria* (Meigen).

NEPHROTOMA DAISENSIS sp. nov. Plate 1, fig. 14.

General coloration yellow and black; antennæ black throughout; mesonotal præscutum almost entirely covered by a black dorsal shield composed of the entirely confluent stripes; scutellum and parascutella black; mediotergite black; pleura yellow, conspicuously variegated by black areas; femora yellow basally, the tips broadly blackened; wings with a strong yellow tinge; stigma long-oval, dark brown; wing tip broadly infumed; Sc_2 ending some distance beyond the origin of Rs , Sc_1 lacking; abdominal tergites orange, the outer segments uniformly blackened, the intermediate tergites with black triangular areas.

Female.—Length, about 16 millimeters; wing, 14.5.

Frontal prolongation of head polished black above, more yellow on sides; nasus black; palpi obscure brownish yellow. An-

tennæ black throughout; flagellar segments (female) with basal enlargements poorly developed; verticils longer than the segments. Head sulphur yellow, the occiput and posterior vertex velvety black, the color extending cephalad to the level of the narrowest part of the anterior vertex and here sending a broad orbital extension to the eyes; ground color restricted to the front, anterior part of vertex and posterior orbits; genæ more pruinose, with long silvery setæ.

Pronotum broadly yellow medially, the sides conspicuously blackened. Mesonotal præscutum almost covered by a large shield-shaped polished black area comprising the usual three stripes that are entirely confluent; yellow ground color restricted to humeral triangles and a smaller linear area before the suture; darkened shield not or scarcely bordered by more opaque black; scutum with lobes black, the obscure yellow ground restricted to the anterior half of the median area and small, brighter yellow, lateral areas above the wing root; scutellum and parascutella black, the surface very weakly pruinose; mediotergite black, very weakly pruinose, brightened by yellow only at extreme anterolateral angle. Pleura yellow, conspicuously variegated by black on the propleura, anepisternum, ventral sternopleurite, ventral meron, ventral pteropleurite, and as a large U-shaped area on the pleurotergite. Halteres obscure yellow throughout. Legs with the coxæ gray pruinose, with conspicuous white setæ, the apices of posterior coxæ obscure yellow; trochanters yellow; femora yellow basally, the tips broadly blackened, more conspicuously so on the forelegs where more than the outer half is included, narrowest on the posterior legs where about the distal fourth is darkened; tibiæ brown, the tips darker; tarsi black. Wings (Plate 1, fig. 14) with a strong yellow tinge, prearcular region and cells C and Sc more saturated yellow; stigma long-oval, dark brown; wing tip broadly infumed; a diffuse brown seam along cord, reaching the posterior margin along distal section of vein Cu_1 ; veins dark brown, more yellow in the brightened areas. About twenty-five stigmal trichia in cell R_1 . Venation: Sc_2 ending some distance beyond origin of the straight Rs , Sc_1 lacking; cell M_1 petiolate; $m-cu$ on M_4 some distance beyond origin.

Abdominal tergites with the ground color orange; basal tergite black, more grayish laterally; tergites two to four black medially, the areas triangular, with the point directed cephalad; succeeding tergites blackened, only the base of the fifth restrictedly pale.

Habitat.—Japan (Honshiu).

Holotype, female, Mount Daisen, Hôki, altitude 2,600 feet, June 6, 1930 (*Hibi*).

The nearest allies appear to be *Nephrotoma ozenumensis* Alexander and *N. pullata* (Alexander), which differ in the details of coloration. The present fly has the entire disk of the præscutum polished black, without indications of different color on the interspaces; the scutellum, parascutella, and mediotergite conspicuously black.

NEPHROTOMA CATENATA sp. nov. Plate 1, fig. 15.

General coloration of mesonotal præscutum yellow, with three polished black stripes that are bordered by velvety black, more broadly so at and near their cephalic ends so all three stripes are interconnected; scutellum, parascutella, mediotergite, and pleura yellow; halteres dusky; wings broad, pale grayish yellow, stigma yellow; abdomen yellow to weakly brownish yellow, unpatterned except for darkenings on tergites six and seven.

Female.—Length, 15 to 16 millimeters; wing, 12 to 12.5.

Frontal prolongation of head light yellow, a little deeper yellow above and on nasus, the latter with black setæ; palpi yellow, the basal two segments weakly darker. Antennæ with basal five segments yellow, the succeeding segments passing into dark brown; flagellar segments (female) scarcely incised; longest verticils subequal to or a little longer than the segments. Head orange-yellow; no occipital brand.

Pronotum clear light yellow above, more reddish yellow on sides. Mesonotal præscutum light yellow, with three polished black stripes that are narrowly bordered by velvety black; extensive invasions of this latter color include the sides of the sclerite, involving the entire lateral border excepting a small yellow spot at midlength of the lateral stripe; the lateral and median stripes broadly connected at cephalic ends of former, restricting the yellow ground color to the posterior interspaces; entire cephalic border of median stripe velvety black; scutum with lobes polished black, the suture and lateral portions velvety black, connecting with the lateral præscutal areas, restricting the yellow ground color to a narrow median area; scutellum, including parascutella, yellow, mediotergite entirely yellow. Pleurotergite and pleura yellow, the latter slightly variegated with reddish yellow on anepisternum and ventral sternopleurite. Halteres dusky, the base of stem restrictedly pale. Legs with the coxæ and trochanters yellow; remainder of legs obscure yellow, the tips of femora and tibiæ very narrowly and weakly

darkened; terminal tarsal segments brownish black. Wings (Plate 1, fig. 15) broad, pale grayish yellow, the prearcular region and cells C and Sc clearer yellow; stigma yellow; veins brown. A few stigmal trichia in cell R_1 . Venation: Sc_2 ending a short distance beyond origin of the oblique Rs , Sc_1 represented by a weak spur; cell M_1 narrowly sessile; m-cu a short distance before fork of M_4 , the latter a corresponding distance before fork of M_3 .

Abdomen yellow to weakly brownish yellow on tergites, but without evident pattern; sixth and seventh tergites more darkened.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, altitude 11,000 feet, August 18, 1934 (Graham). Paratopotype, female.

Nephrotoma catenata is very distinct from the other regional species of the genus in the peculiar pattern of the præscutum and scutum. I cannot indicate any close allies, but the species shows some points of resemblance to *N. minuticornis* Alexander (Japan).

NEPHROTOMA ATROSTYLA sp. nov. Plate 1, fig. 16; Plate 4, fig. 44.

Mesonotal præscutum yellow with three polished black stripes; lateral stripes outcurved but entirely polished; antennæ with basal three segments yellow, the succeeding flagellar segments dark brown, with their bases yellow; occipital band very extensive; central portion of mediotergite darkened; pleura almost uniformly yellow; wings tinged with yellow; stigma rather dark brown; wing tip and a seam on anterior cord brown; abdominal tergites trivittate with black; male hypopygium with both dististyles black; outer style sole-shaped.

Male.—Length, about 11 millimeters; wing, 10.5.

Frontal prolongation of head short, yellow, the nasus a little darker; palpi brown. Antennæ with basal three segments yellow; succeeding flagellar segments bicolorous, dark brown, with the basal enlargements conspicuously yellow; at midlength of the organ, the yellow color becomes more obscure and finally passes into brown; longest verticils nearly as long as the slender segments. Head orange, the extensive occipital and posterior portions of the vertex brown, triangular in outline, the point at anterior end disconnected from a delicate brown median line on vertical tubercle.

Pronotum yellow, weakly darkened on sides. Mesonotal præscutum yellow, with three polished black stripes, the median one very broad in front; lateral stripes strongly outcurved almost

to margin, the outcurved portion equally polished; median area of scutum yellow, the lobes covered by extensive polished black areas; lateral ends of suture black; scutellum brownish testaceous, the parascutella a trifle darker; mediotergite yellow with a broad, dark brown, median stripe on anterior half, the posterior portion more extensively paler brown; mediotergite with setæ on posterolateral portions. Pleura polished yellow, scarcely variegated by more reddish areas, these most evident on ventral portion of pleurotergite. Halteres chiefly pale brown, the apices of knobs a trifle brightened. Legs with coxæ and trochanters yellow; remainder of legs broken. Wings (Plate 1, fig. 16) tinged with yellow, the costal region scarcely brighter; stigma oval, rather dark brown; wing tip narrowly but conspicuously dark brown; a conspicuous brown cloud on anterior cord; posterior cord more narrowly seamed; veins brown. About a score of stigmal trichia in cell R_1 . Venation: Sc_2 ending a short distance beyond origin of Rs ; r-m reduced by approximation of veins; cell M_1 broadly sessile; cell 1st M_2 elongate, parallel-sided; m-cu at fork of M_{3+4} ; cell M_4 narrow.

Abdomen orange, the tergites extensively blackened medially, the basal ring undarkened; lateral borders of tergites conspicuously blackened on outer ring; eighth and ninth segments, including style of hypopygium, chiefly black; basal sternites yellow, the intermediate segments black. Male hypopygium with the tergite (Plate 4, fig. 44, 9*t*) having two broadly flattened, divergent lobes, separated by a U-shaped notch, the blackened spines numerous; dorsal surface of tergite highly protuberant on either side of a narrow median depression. Outer dististyle, *od*, sole-shaped; marginal setæ short, basal ones long and stout. Inner dististyle, *id*, with the apical beak slender; no dorsal crest. Eighth sternite with caudal margin entire; from membrane between the eighth and ninth sternites a depressed rectangular lobe, more or less parallel-sided, the tip obtuse. Gonapophyses exceeding the very small ædeagus, each apophysis unequally bifid at apex (Plate 4, fig. 44, *p*).

Habitat.—Eastern Siberia.

Holotype, male, Samnjur River, near Habarovsk, Ussuri, July 7, 1910 (*Gondatti Expedition*); Russian Academy of Sciences.

The bicolorous flagellar segments, with the bases yellow, together with the black hypopygium, readily separate the present fly from other regional species. By manuscript keys, it runs to *Nephrotoma angustistria* Alexander, of northern Japan, differing

most evidently in all details of structure and coloration of the male hypopygium. The antennæ of the male sex are much shorter than in *angustistria*.

LIMONIINÆ

LIMONIINI

LIMONIA (LIBNOTES) PERPARVULOIDES sp. nov. Plate 1, fig. 17; Plate 4, fig. 45.

Allied to *perparvula*; tips of femora narrowly and abruptly yellow; wings pale grayish subhyaline; stigma oval, pale brown; Sc_1 ending just beyond fork of Rs, Sc_2 at its tip; Rs relatively long and oblique, approximately three times as long as the basal section of R_{4+5} .

Male.—Length, about 4.5 millimeters; wing, 5.

Head broken.

Mesonotal præscutum yellow, darkened medially and less distinctly on the sides; posterior sclerites of notum testaceous-yellow, the scutal lobes weakly darkened. Pleura with the anepisternum and sternopleurite weakly darkened, the posterior sclerites and pleurotergite more testaceous-yellow. Halteres pale, the knobs dark brown. Legs with the coxæ and trochanters testaceous-yellow; femora brownish black, the tips narrowly and abruptly light yellow; tibiæ black, the tarsi a very little paler. Wings (Plate 1, fig. 17) pale grayish subhyaline, the prearcular region and cells C and Sc pale yellow; stigma oval, pale brown; veins brown, more flavous in the yellow areas. Venation: Sc of moderate length, Sc_1 ending just beyond fork of Rs, Sc_2 at its tip; Rs relatively long and oblique, much longer than in *perparvula*, approximately three times the basal section of R_{4+5} ; free tip of Sc_2 and R_2 in transverse alignment; m-cu at midlength of the long cell 1st M_2 ; anal veins beyond origin gently convergent.

Abdominal tergites brown, the lateral margins darker; sternites more yellow. Male hypopygium (Plate 4, fig. 45) much as in *perparvula* but the apex of the rostral prolongation of the ventral dististyle, *vd*, a little stouter. In both species, the surface of the dorsal dististyle has several very delicate setulæ.

Habitat.—Formosa.

Holotype, male, Raisya, altitude 2,500 feet, November 21, 1934 (*Issiki*).

Very closely allied to and possibly only a geographical race of *Limonia* (*Libnotes*) *perparvula* Alexander (Luzon), which differs chiefly in the venation of the radial field. The latter species is now known from two provinces in Luzon (Pampanga

and Tayabas) and shows very little variation in the venation of the radial field. These two species are the smallest representatives of the subgenus so far discovered in the Philippines and northward in eastern Asia.

LIMONIA (LIMONIA) EDURA *sp. nov.* Plate 1, fig. 18.

General coloration reddish brown, the disk of præscutum with indications of three darker stripes; front silvery white; anterior vertex wide; halteres and legs dark; wings with a strong fulvous-brown tinge, with narrow, darker brown seams on the cross-veins and deflections; Rs very long, in alignment with R_{2+3} ; cell 1st M_2 elongate, subequal to vein M_{1+2} beyond it; m-cu shortly before fork of M.

Female.—Length, about 6 millimeters; wing, 6.5.

Rostrum and palpi black. Antennæ with scape and pedicel black; flagellum broken. Front and anterior portion of vertex silvery white; posterior portion of vertex black; anterior vertex wide, the eyes with coarse ommatidia.

Pronotum obscure yellow. Mesonotal præscutum reddish brown, the humeral and lateral portions paling to yellow, the disk with very vague indications of three darker stripes; posterior sclerites of notum dark brown. Pleura dark brown. Halteres relatively short, dusky. Legs with the fore coxæ dark brown, the remaining coxæ and all trochanters more brownish yellow; remainder of legs dark brown. Wings (Plate 1, fig. 18) with a strong fulvous-brown tinge, the prearcular field light yellow; very narrow, darker brown seams at fork of Sc, origin of Rs, stigma, cord, and outer end of cell 1st M_2 , best indicated by the darker veins; veins pale, except as noted above. Venation: Sc relatively long, Sc_1 ending beyond one-third the length of Rs, Sc_2 at its tip; Rs very long, in alignment with R_{2+3} ; free tip of Sc_2 pale, lying shortly basad of the gently arcuated R_2 ; cell 1st M_2 elongate, subequal to vein M_{1+2} beyond it; m-cu shortly before fork of M, about two-thirds the distal section of Cu_1 ; anal veins at bases gently diverging.

Abdomen dark brown, the segment before the hypovalvæ pale. Ovipositor with cerci very small, slender and upcurved, the much larger, compressed hypovalvæ blackened at bases.

Habitat.—Japan (Honshiu).

Holotype, female, Yumoto, Shimotsuke, altitude 5,000 feet, August 7, 1934 (*Issiki*).

Limonia (Limonia) edura is very different from other small regional species of the subgenus. It is somewhat like *L. (L.)*

yakushimensis Alexander, but the alliance is not particularly close and I cannot indicate any other similar species.

LIMONIA (LIMONIA) JUVENCA sp. nov. Plate 1, fig. 19; Plate 4, fig. 46.

General coloration of mesonotum light yellow, the præscutum with a median brown stripe that is constricted at midlength; antennæ (male) relatively elongate; pleura yellow; halteres dusky; legs brown, the femora without paler annuli; wings pale brown, variegated by darker clouds and pale areas; Sc unusually short, Sc₂ ending exactly opposite the origin of Rs, Sc₁ at its tip; m-cu before fork of M; male hypopygium with a single dististyle that terminates in a pendant blackened lobe; ædeagus with the surface covered by dense pale setulæ.

Male.—Length, about 6.5 millimeters; wing, 6.5.

Rostrum and palpi black, the former moderately elongate, approximately one-third to one-fourth the remainder of head. Antennæ brown, the scape a little darker; antennæ elongate, if bent backward extending to the wing root or approximately so; flagellar segments subcylindrical to long-oval, with a dense white pubescence, additional to the short verticils. Head dark grayish brown.

Pronotum and cervical sclerites dark brown, paler laterally. Mesonotal præscutum light yellow, with a conspicuous, bright brown, median stripe that is somewhat constricted at midlength; scutal lobes darkened, the median area pale; scutellum yellow, the parascutella darker; mediotergite brownish testaceous. Pleura yellow. Halteres dusky, the base of stem restrictedly yellow. Legs with the coxæ and trochanters yellow, femora uniformly brown, without sign of apical or subapical brightening; tibiæ and tarsi brown. Wings (Plate 1, fig. 19) slightly teneral, pale brown, variegated by slightly darker clouds and paler areas; the darker clouds include the origin of Rs, cord, outer end of cell 1st M₂, wing tip, and an area in cell R at near midlength; stigma darker brown; veins brown. Venation: Sc very short, Sc₂ ending exactly opposite origin of Rs, Sc₁ shortly before its tip; R₁₊₂ about twice R₂; m-cu a short distance before fork of M.

Abdomen dark brown; hypopygium scarcely brighter. Male hypopygium (Plate 4, fig. 46) with the caudal margin of tergite, 9t, gently emarginate, with conspicuous setæ. Basistyle, *b*, with ventromesal lobe very extensive, appearing as a densely setiferous cushion. Dististyle, *d*, with abundant setæ, the pendant tip constricted and blackened. Gonapophyses, *g*, with mesal-

apical lobe long and slender, the extreme tip narrowed and blackened. *Ædeagus*, *a*, depressed, the entire surface with abundant delicate pale setulæ, the apex with two divergent arms.

Habitat.—Japan (Honshiu).

Holotype, male, Yumoto, Shimotsuke, altitude 5,000 feet, August 5, 1934 (*Issiki*).

The nearest ally of the present species is *Limonia* (*Limonia*) *esakii* (Alexander), of Formosa. It is even closer to specimens from Honshiu that I had formerly considered to represent *esakii*, but which I am now compelled to regard as being at least sub-specifically distinct. The present fly differs from the latter specimens in the unvariegated femora and the unusually short Sc. The latter feature is quite as in the subgenus *Dicranomyia*, but the structure of the male hypopygium is definitely as in *Limonia*.

LIMONIA (LIMONIA) NITOBETI (Edwards).

Limnobia nitobei EDWARDS, Ann. & Mag. Nat. Hist. VIII 18 (1916) 247-248.

Hitherto known only from the unique type male, taken on Arisan, Formosa, altitude 8,000 feet, October 10, 1912, by Nitobe.

Allotype, female, Raisya, Formosa, altitude 3,000 feet, November 24, 1934 (*Issiki*).

Female.—Length, about 8 millimeters; wing, 9.

Differs from the male, as described, only as follows:

Antennæ black throughout. Anterior vertex about as wide as diameter of scape. Mesonotal præscutum with a brown median stripe, additional to the darker lateral stripes. Pleura chiefly intense black, the color involving the ventral anepisternum and all of the sternopleurite, pteropleurite, and pleurotergite, the dorsal anepisternum and dorsopleural region almost entirely yellow. Fore and middle coxæ extensively blackened on outer faces; basal dark ring of femora very narrow and much paler than the black tip. Wings with inner ends of cells 2d M_2 and M_3 (closing cell 1st M_2) about in transverse alignment or with the latter a little closer to the wing base. Dark abdominal rings black or nearly so, involving not only the broad bases but also the adjoining very narrow posterior borders and extreme lateral margins.

LIMONIA (PSEUDOGLOCHINA) MONOCYCLA sp. nov. Plate 1, fig. 20.

Mesonotum brown, the præscutum darker on borders; median region of posterior sclerites of notum pale; flagellar segments with the secondary pubescence much shorter than the verticils;

tibiæ white, each with a single narrow dark ring; wings faintly tinged with brownish yellow; stigma oval, dark brown; Sc long, Sc₁ ending opposite r-m or virtually so; m-cu shortly beyond fork of M; cell 2d M₂ deep; cell 2d A small.

Male.—Length, about 6 to 7 millimeters; wing, 6.5 to 8.

Rostrum brown; palpi black. Antennæ with the scape dark brown, the remainder of organ black; flagellar segments oval, with short but conspicuous apical pedicels to produce a bead-like appearance; longest verticils subequal in length to the segments; secondary pubescence short and inconspicuous; terminal segment longer than the penultimate, the outer end narrowed. Head light fulvous.

Pronotum slightly darkened medially, the sides whitish. Mesonotal præscutum brown medially, bordered laterally by darker brown; scutum dark brown, slightly paler medially; scutellum pale brown, the parascutella darker; mediotergite paler medially than at the sides. Pleura chiefly pale yellow, the ventral sternopleurite dark brown. Halteres dark brown throughout. Legs with the coxæ dark brown, the fore coxæ paler basally; trochanters black; fore femora white, the extreme base and wider apex black; middle femora dusky on basal third, thence paling to dirty white, the tip narrowly black, preceded by a subequal clearer white ring; posterior femora broadly black at both ends, the intermediate half or more only a little paler, brownish black; all tibiæ white, with a narrow black ring just before midlength; tarsi white. Wings (Plate 1, fig. 20) faintly tinged with brownish yellow, cells C and Sc slightly more saturated yellow; stigma oval, dark brown, very conspicuous; veins beyond cord brownish black, basad of cord somewhat paler. Venation: Sc long, Sc₁ ending opposite r-m or virtually so, Sc₂ about opposite fork of Rs; in the paratype figured, Sc is a little shorter; m-cu shortly beyond fork of M; cell 2d M₂ deep, approximately three times its petiole; cell 2d A small but extended, the anal angle weak.

Abdominal tergites chiefly dark brown, the caudal margins restrictedly paler; sternites paler brown, the caudal borders more broadly yellow; hypopygium chiefly pale, the ventral dististyle yellow.

Habitat.—Formosa.

Holotype, male, Kanshirei, altitude 1,500 feet, October 17, 1934 (*Issiki*).

The nearest allies are *Limonia* (*Pseudoglochina*) *angustapicalis* Alexander (Luzon), which differs in the coloration, vena-

tion, and structure of the antennæ, which are longer, with the secondary pubescence of the flagellar segments long and conspicuous; and *L. (P.) uncinctipes* Alexander (Philippines and Borneo), which differs in the wing coloration and venation, as the short Sc , with Sc_1 ending before the fork of Rs .

LIMONIA (PSEUDOGLOCHINA) DIMELANIA sp. nov. Plate 1, fig. 21.

Mesonotal præscutum brown, the anterolateral and cephalic portions white; posterior sclerites of mesonotum dark brown, with a narrow white median line; tibiæ with two narrow black rings; wings strongly suffused with brown, cells C and Sc darker; stigma long-oval, dark brown; Sc , ending about opposite midlength of the long Rs , the latter nearly twice the basal section of R_{4+5} ; cell $2d\ M_2$ a little longer than its petiole; $m-cu$ at fork of M ; vein $2d\ A$ long.

Male.—Length, about 6 millimeters; wing, 6.8.

Rostrum dark brown; palpi black. Antennæ relatively short, black throughout; verticils shorter than the oval segments, the latter with short apical pedicels; secondary pubescence relatively long, only a little shorter than the verticils; terminal segment equal in length to the penultimate. Head orange-fulvous.

Pronotum entirely white. Mesonotal præscutum very convex and protuberant, the anterolateral and cephalic portions white, only weakly darkened medially; remainder of mesonotum rather dark brown, with a narrow white median line, beginning beyond midlength of the præscutum, extending caudad to base of abdomen, narrowly bordered throughout its length by more brownish black. Pleura white, the ventral sternopleurite brownish black. Halteres dark throughout. Legs with the fore coxæ and trochanters dark, the remaining coxæ and trochanters pale; middle leg with femora yellow, paling to white on distal third, the tip narrowly and weakly darkened; posterior femora yellow, the posterior fourth or fifth black, the extreme tip pale; forelegs broken; tibiæ white, each with two narrow black rings, the first at near one-fourth the length, the second just beyond midlength; tarsi white. Wings (Plate 1, fig. 21) strongly suffused with brown, cells C and Sc even darker; stigma long-oval, dark brown; a small dark cloud at origin of Rs ; veins brown. A few scattered trichia at distal end of vein $1st\ A$; trichia shorter than in *riukiensis*. Venation: Sc_1 ending opposite or just beyond midlength of the long Rs , Sc_2 immediately beyond the origin of the latter; Rs nearly two times the basal section of R_{4+5} ; cell $2d\ M_2$ a little longer than its petiole; $m-cu$ at fork of M ; vein $2d\ A$ long, but still shorter than in *riukiensis*.

Abdomen with the tergites dark brown, the central portions and posterior margins of the intermediate segments a little paler; sternites pale; hypopygium dark.

Habitat.—Formosa.

Holotype, male, Kanshirei, altitude 1,500 feet, October 17, 1934 (*Issiki*).

The nearest ally is *Limonia* (*Pseudoglochina*) *riukiensis* Alexander, which differs most conspicuously in the pattern and venation of the wings.

ANTOCHA (ANTOCHA) PLATYPHALLUS sp. nov. Plate 1, fig. 22; Plate 4, fig. 47.

General coloration of mesonotal præscutum light brown; antennæ short, black throughout; halteres pale throughout; wings with a gray tinge, the veins very pale and scarcely apparent; abdomen dark brown, the hypopygium paler; male hypopygium with the dististyles fused basally; ædeagus and subtending apophyses forming a flattened, depressed phallosome.

Male.—Length, about 5.5 millimeters; wing, 6.5.

Rostrum brown; palpi black. Antennæ short, black throughout; flagellar segments oval; terminal segment about one-third longer than the penultimate; verticils a little shorter than the segments. Head brownish gray.

Pronotum dark brown. Mesonotal præscutum with the ground color gray, the disk chiefly covered by three light brown stripes, the median one a little more intensely darkened on cephalic portion; posterior sclerites of notum testaceous-yellow. Pleura testaceous-yellow, weakly infumed on ventral sternopleurite. Halteres pale throughout. Legs with the coxæ and trochanters yellow; remainder of legs pale brown. Wings (Plate 1, fig. 22) with a gray tinge, the prearcular region whitish; veins so pale as to be but little evident against the ground. Venation: R_2 lying a little distad of level of r-m; m-cu shortly before fork of M.

Abdomen dark brown; hypopygium brownish yellow. Male hypopygium (Plate 4, fig. 47) with the dististyles more or less fused on basal fourth, almost superimposed in a position of rest; inner style a little dilated near base. Ædeagus unusually broad, depressed, the apex trilobed, the organ subtended by gonapophyses with acute, mesally directed tips. Inner gonapophyses, *g*, with a short branch, the apex obtusely rounded.

Habitat.—Japan (Honshiu).

Holotype, male, Yumoto, Shimotsuke, altitude 5,000 feet, August, 5, 1934 (*Issiki*).

The coloration of the wings, with pale veins, is much like that of *Antocha* (*Antocha*) *sagana* Alexander, but the structure of the male hypopygium is quite different from that of any regional species so far described.

ERIOPTERINI

GONOMYIA (GONOMYIA) LATIFOLIA sp. nov. Plate 1, fig. 23; Plate 4, fig. 48.

Allied to *foliacea*; rostrum orange-yellow; mesonotal præscutum and scutum dark brown, sparsely pruinose; scutellum clear yellow; pleura pale brown, striped longitudinally with whitish; knobs of halteres weakly darkened; legs brownish black; wings grayish subhyaline, the stigma pale brown; Sc long, Sc₁ ending at about midlength of Rs; m-cu about one-half its length beyond fork of M; abdominal tergites dark brown; male hypopygium with the outer dististyle a flattened, foliaceous blade, the surface sparsely setiferous; inner dististyle with the apical spine acute at tip; ædeagus complex, the ventral margin with several pale spinous points.

Male.—Length, about 4.5 millimeters; wing, 4.8.

Rostrum orange-yellow; palpi dark. Antennæ black throughout. Head gray.

Mesonotal præscutum and scutum dark brown, sparsely pruinose, the humeral region of the former restrictedly brightened; pseudosutural foveæ dark; extreme posterior margin of scutal lobes and anterior half of median area yellow, the posterior half of latter black and heavily pruinose; scutellum clear light yellow, the parascutella dark; mediotergite black, heavily pruinose. Pleura pale brown, striped longitudinally with whitish, the latter including the dorsopleural region and a ventral stripe from behind the fore coxæ to the base of abdomen. Halteres of moderate length only, pale, the knobs weakly darkened. Legs with the coxæ and trochanters brown; remainder of legs brownish black. Wings (Plate 1, fig. 23) grayish subhyaline, the prearcular region narrowly yellowish; stigma pale brown, ill-delimited; veins brownish black. Costal fringe of moderate length. Venation: Sc₁ ending almost opposite midlength of Rs, Sc₂ close to its tip; m-cu about one-half its length beyond fork of M.

Abdominal tergites dark brown, the outer sternites somewhat paler. Male hypopygium (Plate 4, fig. 48) with the outer dististyle, *od*, a flattened foliaceous blade, much as in *foliacea*, the tip exceedingly acute; surface of style with setæ small and reduced in number, the mesal edge quite glabrous. Inner disti-

style, *id*, almost as long, complex in structure, as shown by the figure; outer arm blackened and acute at tip, nearer base with two spinous points and a powerful black spinous seta; inner lobe with two fasciculate bristles. Gonapophyses, *g*, blackened, the two together appearing more or less lyriform, the outer margin of each with a small acute spine, much as in *bibarbata*. Ædeagus, *a*, complex, the ventral margin with several pale spinous points that are not present in *foliacea*.

Habitat.—Formosa.

Holotype, male, Kanshirei, altitude 1,500 feet, October 19, 1934 (*Issiki*).

The nearest relative is *Gonomyia* (*Gonomyia*) *foliacea* Alexander (Formosa), which differs in the coloration of the thorax and legs and in the structure of the male hypopygium, especially the inner dististyle and ædeagus.

GONOMYIA (LIOPHLEPS) PRÆDITA sp. nov. Plate 1, fig. 24.

Belongs to the *abbreviata* group; most nearly allied to *gracilistylus*; wings gray, without brown tinge, narrow, the anal cells correspondingly restricted; vein R_3 with macrotrichia throughout its length.

Female.—Length, about 4.5 millimeters; wing, 4.8.

Rostrum brown; palpi black. Antennæ dark throughout; flagellar segments elongate, the verticils relatively long and conspicuous (for the female sex). Head dark.

Pronotum yellow. Mesonotal præscutum pale brown, sparsely pruinose, the humeral region yellow; pseudosutural foveæ pale; posterior sclerites of notum paler, the scutellum yellow, dusted with whitish pollen. Pleura chiefly pale, the anepisternum somewhat darkened. Halteres moderately elongate, the stem pale, the knob weakly darkened. Wings (Plate 1, fig. 24) tinged with gray, the stigmal region undarkened; veins pale brown; wings much narrower than in *gracilistylus*, the cells correspondingly narrowed, most evident in the anal field. Vein R_3 with macrotrichia throughout its entire length. Venation: R_s angulated and spurred at origin; distance on costa between tips of veins R_{1+2} and R_3 about equal in length to the latter vein.

Abdominal tergites brown, the sternites more yellowish. Ovipositor with the valves long and slender, especially the cerci.

Habitat.—Formosa.

Holotype, female, Kanshirei, altitude 1,500 feet, October 17, 1934 (*Issiki*).

The nearest relative of the present fly is *Gonomyia* (*Lipophleps*) *gracilistylus* Alexander (Japan: Honshiu, Kiushiu), which differs in the broad, strongly tinted wings and details of trichiation. The male sex in this group of species offers unusually strong characters, and it may be expected that additional structures will be available when the male of the present insect is discovered. I formerly placed the members of this group in the subgenus *Gonomyia*, but now follow Edwards⁷ in considering the *abbreviata* group as being more correctly placed in *Lipophleps*.

⁷ Journ. Fed. Malay St. Mus. 14 (1928) 103.

ILLUSTRATIONS

[a, *Ædeagus*; b, *basistyle*; d, *dististyle*; g, *gonapophysis*; id, *inner dististyle*; od, *outer dististyle*; p, *phallosome*; s, *sternite*; t, *tergite*; vd, *ventral dististyle*.]

PLATE 1

- FIG. 1. *Ctenacroscelis ignicaudatus* sp. nov., venation.
 2. *Ctenacroscelis quadrifasciculatus* sp. nov., venation.
 3. *Tipula* (*Arctotipula*) *miyadai* sp. nov., venation.
 4. *Tipula* (*Schummelia*) *stipata* sp. nov., venation.
 5. *Tipula* (*Lunatipula*) *justa* sp. nov., venation.
 6. *Nephrotoma integra* sp. nov., venation.
 7. *Nephrotoma esakii* Alexander, venation.
 8. *Nephrotoma serristyla* sp. nov., venation.
 9. *Nephrotoma profunda* sp. nov., venation.
 10. *Nephrotoma bifascigera* sp. nov., venation.
 11. *Nephrotoma sublamellata* sp. nov., venation.
 12. *Nephrotoma chosensis* sp. nov., venation.
 13. *Nephrotoma martynovi* sp. nov., venation.
 14. *Nephrotoma daisensis* sp. nov., venation.
 15. *Nephrotoma catenata* sp. nov., venation.
 16. *Nephrotoma atrostyla* sp. nov., venation.
 17. *Limonia* (*Libnotes*) *perparvuloides* sp. nov., venation.
 18. *Limonia* (*Limonia*) *edura* sp. nov., venation.
 19. *Limonia* (*Limonia*) *juvenca* sp. nov., venation.
 20. *Limonia* (*Pseudoglochina*) *monocycla* sp. nov., venation.
 21. *Limonia* (*Pseudoglochina*) *dimelania* sp. nov., venation.
 22. *Antocha* (*Antocha*) *platyphallus* sp. nov., venation.
 23. *Gonomyia* (*Gonomyia*) *latifolia* sp. nov., venation.
 24. *Gonomyia* (*Lipophleps*) *prædita* sp. nov., venation.

PLATE 2

- FIG. 25. *Ctenacroscelis ignicaudatus* sp. nov., five basal segments of antennal flagellum, male.
 26. *Ctenacroscelis ignicaudatus* sp. nov., male hypopygium, details.
 27. *Ctenacroscelis ignicaudatus* sp. nov., male hypopygium, details.
 28. *Ctenacroscelis libertus* sp. nov., male hypopygium, details.
 29. *Ctenacroscelis quadrifasciculatus* sp. nov., five basal segments of antennal flagellum, male.
 30. *Ctenacroscelis quadrifasciculatus* sp. nov., male hypopygium, details.
 31. *Ctenacroscelis regius* sp. nov., five basal segments of antennal flagellum, female.
 32. *Tipula* (*Arctotipula*) *miyadai* sp. nov., male hypopygium, details.
 33. *Tipula* (*Schummelia*) *stipata* sp. nov., male hypopygium, details.
 34. *Tipula* (*Lunatipula*) *justa* sp. nov., male hypopygium, details.

PLATE 3

- FIG. 35. *Nephrotoma integra* sp. nov., male hypopygium, details.
36. *Nephrotoma esakii* Alexander, male hypopygium, details.
37. *Nephrotoma serristyla* sp. nov., male hypopygium, details.
38. *Nephrotoma profunda* sp. nov., male hypopygium, details.
39. *Nephrotoma bifascigera* sp. nov., male hypopygium, details.
40. *Nephrotoma bifascigera* sp. nov., male hypopygium, details.

PLATE 4

- FIG. 41. *Nephrotoma sublamellata* sp. nov., male hypopygium, details.
42. *Nephrotoma chosensis* sp. nov., male hypopygium, details.
43. *Nephrotoma martynovi* sp. nov., male hypopygium, details.
44. *Nephrotoma atrostyla* sp. nov., male hypopygium, details.
45. *Limonia* (*Libnotes*) *perparvuloides* sp. nov., male hypopygium.
46. *Limonia* (*Limonia*) *juvenca* sp. nov., male hypopygium.
47. *Antocha* (*Antocha*) *platyphallus* sp. nov., male hypopygium.
48. *Gonomyia* (*Gonomyia*) *latifolia* sp. nov., male hypopygium.

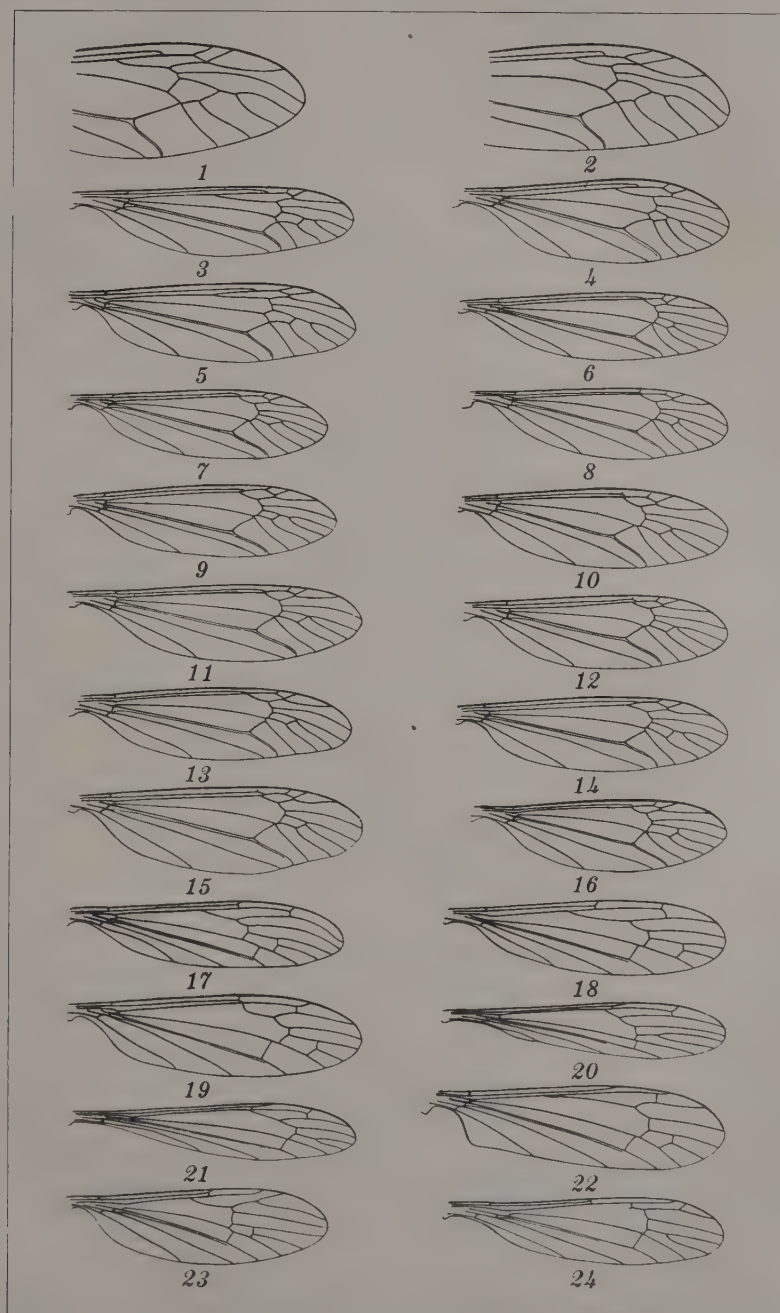


PLATE 1.

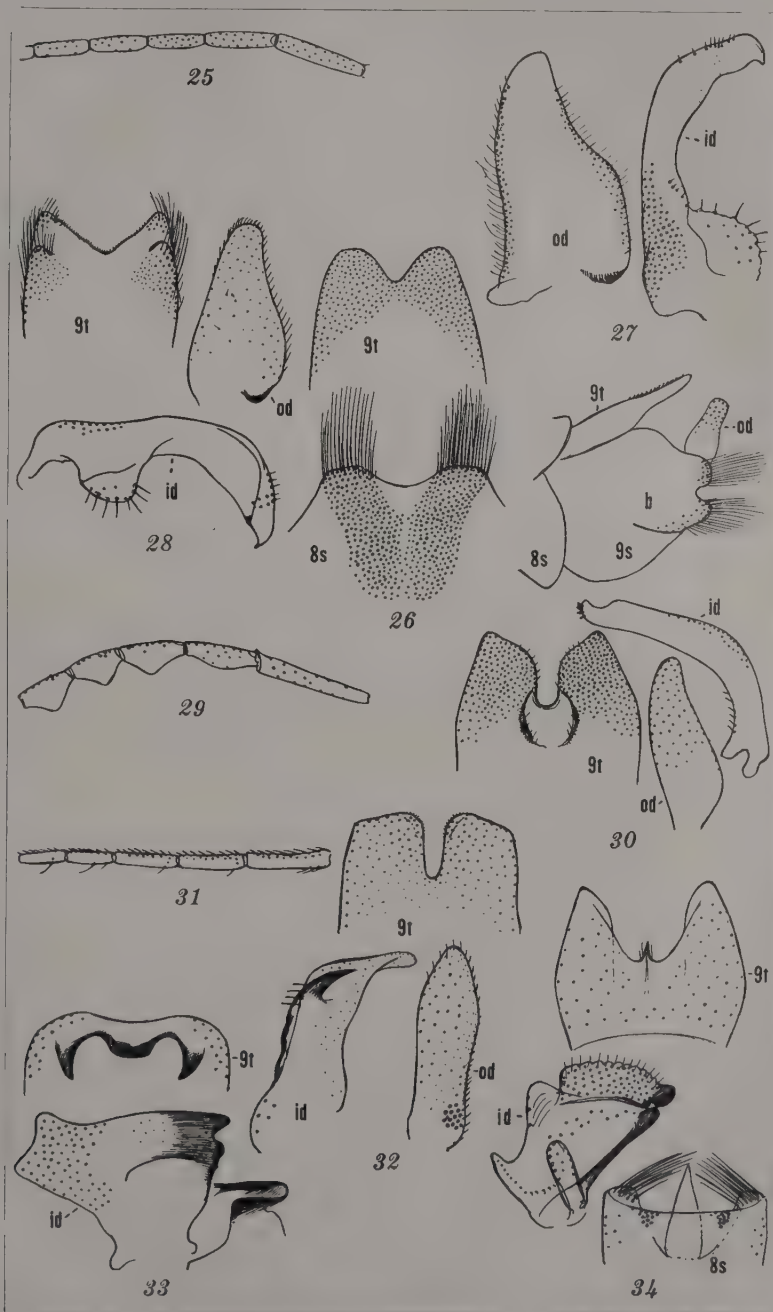


PLATE 2.

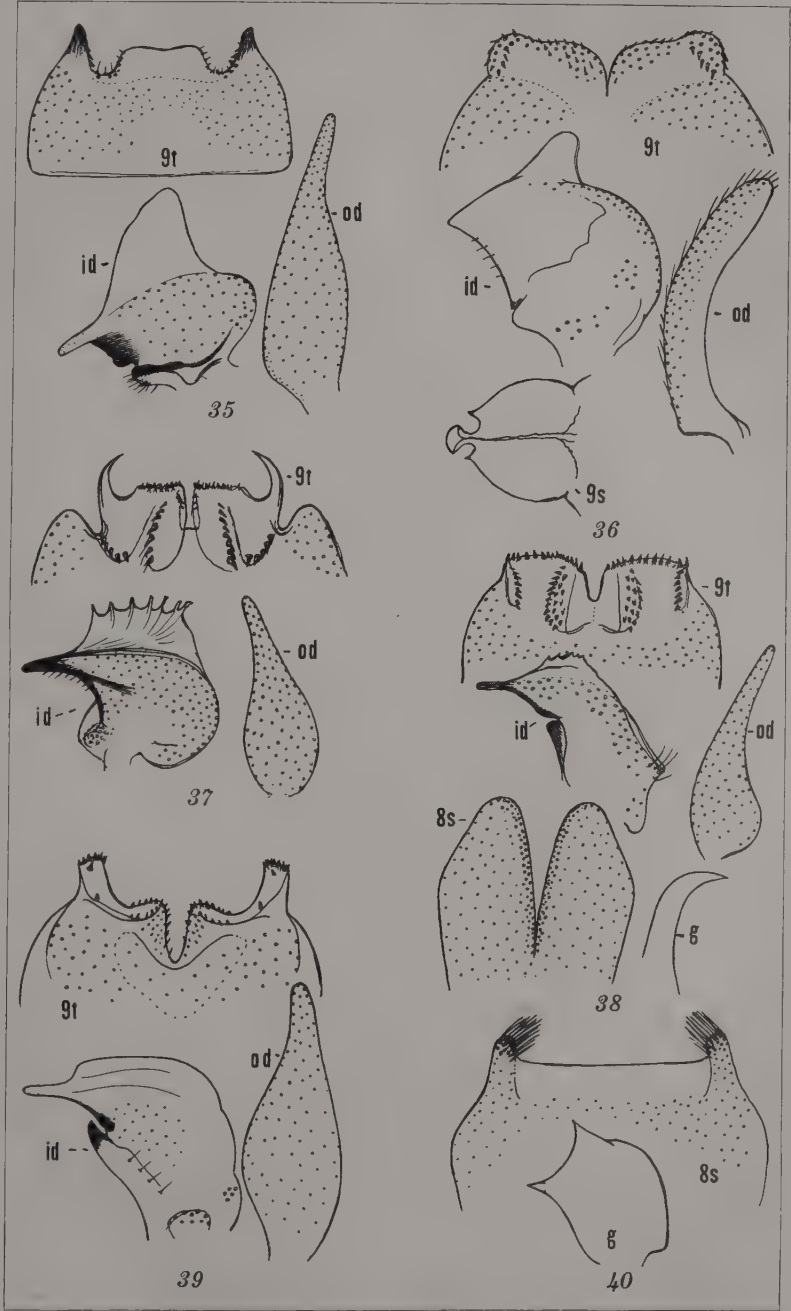


PLATE 3.

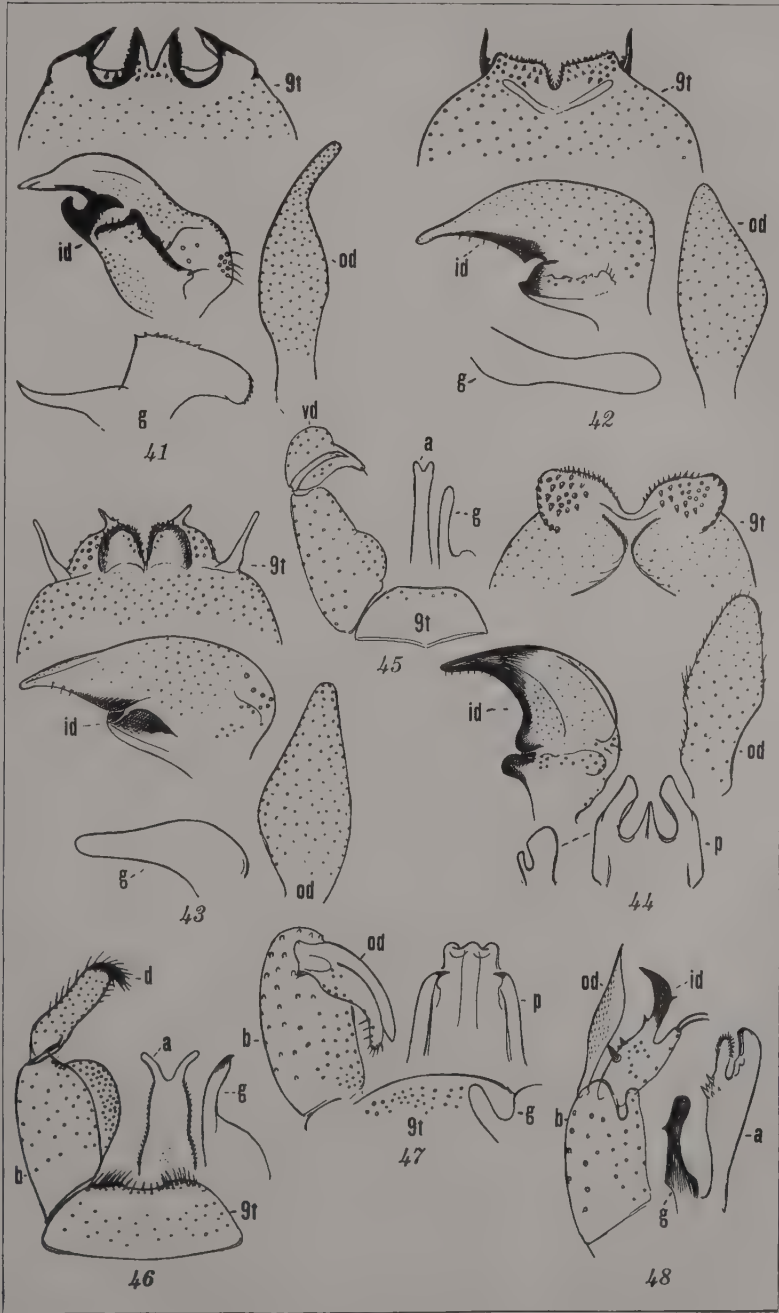


PLATE 4.

NEW LONGICORN BEETLES FROM FORMOSA, II (COLEOPTERA: CERAMBYCIDÆ)

By J. LINSLEY GRESSITT

Of the University of California, Berkeley

The present paper is a continuation of a series begun as "New longicorns from the Japan Empire."¹ Herein are described as new eleven species of the tribes Lepturini and Molorchini of the subfamily Cerambycinæ. All the material dealt with in this paper was collected in Formosa by the author in 1932 and 1934. The types are preserved in the United States National Museum in Washington, D. C., the California Academy of Sciences in San Francisco, and the author's collection.

LEPTURINI

Genus PSEUDOPIDONIA Pic, 1900

PSEUDOPIDONIA ÆNIPENNIS Gressitt sp. nov.

Minute, subparallel; body dull grayish black, elytra dull bluish green, last two abdominal segments reddish testaceous, first and second antennal segments, anterior and ventral portions of head, including palpi and sides of frons, and legs, except tarsi, testaceous, extreme apices of third and fourth antennal segments slightly reddish, legs slightly dark on apices of femora above and external margins of tibiae; body, except antennæ, largely clothed with fine, decumbent, testaceous hairs, which are longer and more obliquely inclined on elytra, a few long erect hairs on front and underside of head.

Head longer than broad, narrowed and elongate before eyes; longitudinally obliquely, then transversely obliquely narrowed behind; eyes almost entire, broader before than behind; vertex raised and slightly concave; frons broader than long; clypeus nearly as long as broad; mandibles long; last palpal segment broadly obliquely truncated at apex; entire dorsal surface, except mandibles, densely and finely punctured, more sparsely on clypeus. Antennæ as long as the body; scape arched, barely

¹ Pan-Pacific Entomol. 9: 163-170; Philip. Journ. Sci. 55 (1934) 379-386; 57 (1935) 181-194.

reaching to neck; second segment longer than broad; third segment barely longer than scape; fourth, sixth, and seventh equal and hardly shorter than third; fifth one-third longer than fourth; eighth to last shorter and subequal. Prothorax slightly longer than broad, campanulate, slightly constricted near apex and base; apex two-thirds as broad as base; disc moderately swollen; surface minutely and densely punctured. Scutellum triangular, slightly longer than broad. Elytra slightly more than twice as long as broad, parallel, narrowed and rounded at apices; surface fairly heavily punctured on basal two-thirds, more finely posteriorly. Abdomen with the segments subequal in length, the last two slightly shorter. Legs fine; femora hardly swollen; tarsi with the first segment nearly as long as the two following in anterior and middle pairs, slightly longer in the hind pair, apical segment long, the claws testaceous. Length, 6 millimeters; breadth, 1.65.

Holotype, female, a unique, in the author's collection, taken by the author at Reimei, Hassenzan, Formosa, at an altitude of 2,350 meters, June 26, 1934.

Differs from all the known species of the genus in possessing entirely bluish green elytra. Possibly related to *P. albomaculata* Matsushita, but has the first segment of hind tarsi barely longer than following two segments united, instead of twice as long as in the latter, besides differing in coloration.

PSEUDOPIDONIA SUBÆNEUS Gressitt sp. nov.

Minute and parallel; body black, head with the ventral and anterior portions, including sides of frons, testaceous, antennæ with the first two segments testaceous, the following reddish brown, becoming black towards apex, elytra dull greenish black, each with a testaceous band from base to one-third from apex, which is broad at base, covering humerus, gradually narrowing to its termination, with its internal margin parallel with suture and external margin oblique with a slight projection towards external margin of elytron one-third from base, ventral surface with prosternum and basal margin of first abdominal segment reddish testaceous, last two abdominal segments slightly dark reddish brown, legs, including coxæ, testaceous, tarsi and tibiæ externally black; body finely clothed with minute testaceous hairs, longer and less reclining on elytra.

Head barely longer than broad, gradually narrowed behind eyes towards neck; occiput minutely punctulate; eyes swollen, nearly round; frons, clypeus, and labrum each about twice as

broad as long. Antennæ one-fourth longer than body; fourth, sixth, and seventh segments subequal, longer than scape, fifth nearly half again as long as scape, last four subequal. Prothorax nearly half again as long as broad; hardly constricted near apex and base; apex two-thirds as broad as base; disc swollen longitudinally, with almost a carina behind middle; surface densely and minutely punctulate. Scutellum triangular. Elytra very slightly concave at sides; apices narrowed and rounded, surface heavily punctured, more moderately at apices. Legs fine; tarsi elongate, first segment of hind pair longer than following two united. Length, 6.5 millimeters (elytra, 4.2); breadth, 1.7.

Holotype, male, a unique, in the author's collection, taken by the author at Hassenzan, Formosa, at an altitude of 1,300 meters, June 24, 1934.

This species is closely related to *P. ænipennis* Gressitt, although differing markedly in the coloration of the elytra. It has the prothorax longer, less constricted at apex and base, and more swollen above, the head is shorter and less abruptly narrowed at neck, the eyes are more rounded and the elytra are broader and more heavily punctured at apices.

PSEUDOPIDONIA OCCIPITALIS Gressitt sp. nov.

Male.—Narrow, subelongate, antennæ and legs fine; testaceous and black; head reddish testaceous, except eyes, neck above, and region behind eyes, which are black, antennæ testaceous, with the apices of third and following segments and the apical segments dull, prothorax testaceous with the sides and upper part of swollen portion blackish, scutellum reddish brown, elytra testaceous with a narrow submarginal black stripe, which extends around apex to sutural angle, and a narrow sutural stripe, which broadens slightly before, but does not reach apex, ventral surface subrufotestaceous, marked with black on mesepisternum, sides of metasternum and first two abdominal segments, legs subrufotestaceous with apices of femora and outer sides of tibiæ and tarsi blackish; body thinly clothed with short, decumbent, golden hairs, head with a few long erect hairs, antennæ naked.

Head narrowed and abbreviated before eyes, narrowed and obliquely constricted behind eyes; eyes moderately large, swollen, rounded-oval, very slightly emarginate; occiput swollen, granulose; vertex slightly concave; frons twice as broad as long, granulose punctate at sides; labrum and clypeus broad, slightly punctate; maxillary palpi with last segment flattened, obliquely

truncate and slightly rounded apically; genæ very short. Antennæ slightly longer than body; third segment longer than scape and shorter than fifth; fourth two-thirds as long as third and practically as long as sixth. Prothorax longer than broad, narrowly swollen above, swollen and subtuberculate at sides, constricted slightly near base and strongly near apex; surface granulose punctate. Scutellum longer than broad, rounded behind. Elytra long, slightly narrowed posteriorly, subrounded truncate apically, swollen near scutellum and heavily punctate on basal three-fourths. Ventral surface glabrous and shiny below lateral prothoracic swellings; breast and abdomen minutely granulose punctate; fore middle coxæ narrow; mesepimeron narrow internally. Legs long and fine; first segment of hind tarsus slightly longer than the following two united, the last segment subequal to the second.

Female.—Elytra shorter, last segment of maxillary palpi hardly broadened, antennæ barely as long as the body, largely dull brown, scape reddish, elytra with the two black stripes very broad, leaving only a narrow marginal and a moderate discal testaceous stripe, legs with the apical portions of femora and the tibiæ and tarsi largely blackish. Length, 8.5 to 10 millimeters; breadth, 2.2.

Holotype, male (No. 51014, United States National Museum), Taiheizan, northeastern Formosa, altitude 2,000 meters, May 10, 1932; paratype, male, Kyuhabon, near Musha, central Formosa, altitude 1,900 meters, May 21, 1932; paratopotype, female, Taiheizan, Formosa, May 8, 1932, and paratype, female, San-kakuho, near Musha, Formosa, altitude 2,100 meters, May 20, 1932; all taken by the author.

Closely related to *P. discoidalis* Pic, of Japan, but much narrower, with the maxillary palpi less broadened, the femora less thickened, the occiput and vertex reddish brown instead of black, and the femora largely testaceous instead of largely black.

Genus LEPTURA Linnæus, 1758

LEPTURA (?) OCHRACEOVENTRA Gressitt sp. nov.

Elongate, shoulders broad, elytra somewhat narrowed posteriorly, their sides straight; largely shiny black above and ochraceous straw color beneath, antennæ with last half of the eighth segment, the ninth, the tenth, and base of the eleventh segments whitish testaceous, scutellum and the elytra near suture at base and a reversed parenthesis-shaped area at middle

of each side ochraceous, the latter mark on each elytron not touching suture or margin and from above seeming to inclose a round black spot, a small subdetached lateral spot on each elytron before the parenthesis-shaped spot, underside of head, and last abdominal segment black, outer portions of fore and middle tibiæ narrowly, hind tibiæ and tarsi dull to black, labrum and genæ slightly ochraceous; body fairly naked, with sparse and very short obliquely inclined hairs, denser on the thoracic sterna and longer and more erect on head, pronotum, and apices of second to seventh antennal segments, abdomen glabrous; head rather finely punctate, basal antennal segments more finely and densely so, pronotum very finely and sparsely punctate, elytra more deeply, but finely so.

Head very long, equal to prothorax and narrower than its width at base, strongly constricted from posterior margin of eyes, which are prominent, swollen and rounded externally; pre-ocular portion constricted and elongate, with the sides parallel; occiput subsulcate longitudinally; vertex depressed behind the antennal tubercles, which are broad and concave between; frons subparallel, medially grooved, apically depressed and separated from the clypeus by a transverse groove; clypeus large, broader than long; labrum short; genæ very large; maxillary palpi with the last segment large, twice as long as broad, transversely truncate apically. Antennæ as long as the body; the latter segments somewhat thickened, cylindrical, hardly broader at their apices; the basal segments gradually thickened and rounded at apices; scape thickened apically and slightly arched; second segment longer than broad; third segment longer than scape and one-third longer than fourth; fourth shorter than scape and three-fifths as long as fifth; fifth one-half longer than sixth; sixth to tenth slightly decreasing; eleventh subequal to ninth. Prothorax longer than broad, subcampanulate, constricted before apex, which is again dilated forming a collar, sides not prominent, acutely produced at base, which is three-fourths as broad as elytra; basal margin slightly sinuate. Scutellum narrow, subtriangular. Elytra long; shoulders broad; sides straight, apices truncate with the external angles strongly produced, the sutural angle less so, swollen near suture at base, behind which it is narrowly and obliquely concave, likewise slightly concave at each side of suture. Ventral surface impunctate; fore coxæ practically adjacent, prominent; abdomen with the segments subequal in length. Legs fine, the femora very slightly swollen; hind femora slightly sinuous; first segment of middle tarsi not

as long as remaining segments combined, that of hind pair slightly longer. Length, 14 millimeters; breadth, 3.

Holotype, male, a unique, in the author's collection, taken by the author at Hassenzan, north-central Formosa, altitude 1,800 meters, June 24, 1934.

This species is almost identical in markings with *Strangalina basiplicata* (Fairmaire), of China, but the latter has the last segment of the maxillary palpi long, the prothorax less constricted anteriorly, more swollen medially, and less expanded basally, the scutellum bilobed apically, the elytra without a strong apical spine, and the metasternum with two thornlike projections posteriorly; further *basiplicata* has the mesothorax (except coxæ) and the metepisternum black and abdomen entirely reddish testaceous. *Leptura* (?) *ochraceoventra* is somewhat similar to *Eustrangalis viridipennis* Gressitt in structure, but does not have the prothorax strongly constricted before and behind or swollen in the middle, and therefore cannot enter the latter genus.

Genus ANOPLODERA Mulsant, 1839

ANOPLODERA (?) TRICOLOR Gressitt sp. nov.

Elongate, prothorax narrow, elytra narrowed behind middle; black, with the elytra bright metallic green, the prothorax orange, the last abdominal segment, intercoxal process of first abdominal segment, apex of second antennal segment, and a line on the ventral side of second and third antennal segments dull orange, the palpi testaceous; body thinly clothed with short, pale hairs.

Head longer than broad, very strongly constricted behind eyes, the neck narrow; surface moderately finely punctate; eyes swollen, subtriangular, narrowly indented internally; frons squarish, longitudinally grooved to apical smooth portions; clypeus large, trapeziform; labrum short, fringed apically with testaceous hairs; palpi of each pair with their apical segments more than twice as long as broad, each thickest before apex and subtransversely truncated; vertex swollen at each side next to antennal supports, which are close; occiput broad and slightly depressed. Antennæ as long as the body, the first four segments punctate and shiny, the remaining segments dull and broadened; scape short, arched, slightly thickened towards apex; second segment broader than long; third and fourth segments equal to each other and to scape in length; fifth to tenth segments subequal and each slightly longer than fourth; eleventh longer than tenth. Prothorax campanulate, longer than broad, very slightly expanded

basally; apex two-thirds as broad as base; base three-fifths as broad as elytra at base; basal margin concave on each side of middle, the middle portion of margin narrowly greenish black; surface finely and evenly punctate, clothed with a thin golden pile directed towards posterior part of disc. Scutellum black; triangular, the apex acute. Elytra highly metallic, with very deep and dense punctures; narrowed from shoulders to beyond middle, then slightly broadened before apex; apices rounded externally and transversely truncate, internal angles nearly right angles. Ventral surface clothed with silvery hairs; meso- and metasternum granulose; abdomen minutely punctate; fore coxæ prominent, conical, adjacent, angulate externally; abdomen not reaching to apices of elytra, first four segments subequal in length, the last longer. Legs with femora swollen near apices; tibiæ straight, hind tarsi as long as femora or tibiæ, the first segment equal in length to second and third combined and also to last segment; the second segment nearly twice as long as third. Length, 13 millimeters; breadth, 3.

Holotype, a unique, probably a male, in the author's collection; taken by the author at Hassenzan, Formosa, altitude 2,000 meters, June 26, 1934.

I have referred this species to *Anoplodera* because of the structure of the prothorax, but it is strikingly contrasted to the true members of the Holarctic genus, with its black head, orange prothorax, and heavily punctured metallic green elytra, which are narrowed after the basal portion as in *Strangalina*.

Genus ANOPLODERMOPHA Pic, 1901

ANOPLODERMOPHA BINOTATA Gressitt sp. nov.

Small, abbreviate, narrowed posteriorly; black, the elytra shiny, entire abdomen and an irregular short oblique spot touching the shoulder of each elytron rufocastaneous, tarsal claws and tibial spurs light brown, palpi dark chesnut.

Head broader than prothorax, strongly constricted at neck, abbreviate in front of eyes, which are large and obliquely indented internally; occiput broad and punctate; vertex slightly depressed between antennal supports; frons very short, with an apical subtriangular glabrous area; clypeus twice as broad as long, with a few punctures; labrum short; last segment of maxillary palpi more than twice as long as broad, rounded at apex. Antennæ nearly as long as the body; basal five segments shiny black and punctate, remainder dull and clothed with grayish pubescence; scape arched, hardly thickened towards apex; second

segment longer than broad, third and fourth segments equal in length and shorter than scape; fifth to ninth segments equal, tenth shorter and eleventh longer; sixth to last segments thicker. Prothorax appreciably longer than broad; sides parallel behind middle, apex narrowed, apical margin not expanded; base three-fifths as broad as base of elytra, not produced; surface finely and densely punctate. Scutellum triangular and dull. Elytra short, less than one and one-half times as long as head and prothorax united, shorter than abdomen, sides narrowed to beyond middle, then slightly expanded; apices transversely rounded-truncate; surface finely punctured in rows; a concave area in middle along suture. Body clothed below with pale hairs, fewer on latter part of abdomen, which is shiny. Femora swollen, the hind pair least so and slightly flexed; first segment of middle tarsi equal in length to second and third combined and to last, the first segment of hind tarsi nearly as long as remaining segments united. Length, 7 millimeters; breadth, 2.

Holotype, a unique, in the collection of the author, taken by the author at Pianan-Ambu, northern Formosa, altitude 1,750 meters, May 12, 1932.

Closely related in structure to *A. discale* Gressitt, of China, but differs in having the elytral spots smaller, darker, and centered more anteriorly, the abdomen light chestnut instead of black, the clypeus much shorter, the prothorax narrower with the apical margin not expanded, and the elytra shorter with the punctures in rows.

ANOPLODERMOPHA BREVA Gressitt sp. nov.

Male.—Minute, abbreviated, narrowed posteriorly; body black, the elytra shiny metallic blue, abdomen, except first segment and basal portion of second segment, and femora, except bases and apices, pale orange-castaneous, labrum and palpi testaceous-brown; body clothed with short, suberect, black hairs.

Head broader than prothorax, abbreviated anteriorly; eyes large, oblong-ovate, slightly indented internally behind middle with an oblique angle; obliquely narrowed for a short distance behind eyes, then transversely constricted into a narrow neck; occiput very broad; vertex very slightly concave between the antennal tubercles, with a slight swelling above at each side; frons extremely short, broader than long, with a midlongitudinal line continued from base of occiput, which divaricates forming a glabrous, flattened triangle separated from clypeus by a slightly arched deep transverse groove; clypeus very large, convex, nearly

as long as broad, slightly narrower at apex; labrum membranous, very short; last segment of maxillary palpus broadest in middle, subtruncate apically; genæ very short; upper portions of head fairly densely punctate, frons and clypeus more finely so. Antennæ nearly as long as the body; scape narrow, arched, not thickened at apex; second segment longer than broad; third segment shorter than fourth or scape; fifth longer than fourth, the following segments gradually slightly shorter, the last longer. Prothorax campanulate, longer than broad; sides meagerly swollen; disc arched; base not dilated, three-fifths as broad as elytra at base; surface less finely punctured than head, the punctures broader and shallower at sides. Scutellum narrowly triangular, dull black. Elytra broad at shoulders, narrowed in middle portion, slightly broader near apex than behind middle; apices subtransversely truncate, rounded slightly at both angles; slightly depressed in central portion near suture; surface regularly and finely punctate. Ventral surface finely granulose to punctate. Legs fine, the fore and middle tibiæ somewhat swollen, the hind pair less so; tarsi of each pair narrow, nearly as long as the respective tibiæ, first segment of middle pair subequal in length to following two segments, first segment of hind pair one and one-half times as long as following two segments.

Female.—Elytra dark lavender; antennæ slightly shorter, with the segments thickened. Length, 6 millimeters; breadth, 1.65.

Holotype, male (No. 3991, California Academy of Sciences, entomology), taken by the author at Arisan, central Formosa, altitude 2,250 meters, June 7, 1932; allotype, female, May 24, 1934, and paratype, male, June 6, 1932, in the author's collection.

Closely related in structure and form to *A. discalis* Gressitt and *A. binotata* Gressitt, differing in its smaller size and its blue or violet elytra.

Genus *STRANGALINA* Aurivillius, 1912

STRANGALINA ANGUSTISSIMA Gressitt sp. nov.

Elongate, extremely narrowed behind the middle, antennæ thickened apically, elytra shorter than abdomen; black, each elytron with a large basal discal colorless semitransparent area, which closely borders suture from behind scutellum to three-fifths distance from base, gradually narrowing to an acute ending, but hardly approaches nearer than half elytron width to exter-

nal margin, tibial spurs and tarsal claws dull reddish brown; body finely clothed with short silvery pubescence, blacker on elytra, abdomen nearly glabrous, head with a few erect hairs, antennæ with short black hairs on basal segments and a few hairs at apex of each segment; head minutely and densely punctured, breast finely granulose punctate, abdomen minutely punctulate, extremely so on basal portion of each segment.

Head broad; anterior portion parallel-sided but abbreviated; eyes strongly swollen, subglobose; vertex narrow, concave; frons squarish; clypeus trapezoidal; last segment of maxillary palpi narrow, subobliquely truncate apically. Antennæ as long as the body (male), the segments thickened apically; scape short, slightly thickened; second segment broader than long; third two-thirds again as long as scape; fourth two-thirds as long as third; fifth hardly shorter than third; sixth to tenth slightly shorter; eleventh equal to seventh. Prothorax half again as long as broad, not expanded basally, constricted at apex, very slightly swollen just before middle, slightly narrowed between middle and base; dorsal surface meagerly swollen; surface moderately punctured on upper part of disc, very finely near base and on sides; base three-fourths as broad as elytra at base, the posterior margin broadly produced in middle. Scutellum narrowly triangular. Elytra very strongly narrowed after basal third, reaching just beyond third abdominal segment, narrowly, and slightly obliquely, truncate at apex. Abdomen very fine, cylindrical, each segment excavated below. Legs very fine, the hind pair exceedingly long, with femora reaching to elytral apices, tibiæ slightly sinuate, tarsi longer than tibiæ and exceedingly fine, with the first segment slightly less than following united and the second hardly as long as the remaining united. Length, 11.7 millimeters (9.7 to elytral apices); breadth, 2.

Holotype, male, a unique, in the author's collection, taken by the author at Hassenzan, Formosa, altitude 1,500 meters June 26, 1934.

Somewhat similar to *Strangalina lineigera* (Fairmaire), but much more attenuated and the elytra much shorter and narrower and the abdomen and hind tarsi much longer and finer.

STRANGALINA SUTURALIS Gressitt sp. nov.

Somewhat abbreviated, not extremely narrowed posteriorly; black, each elytron with a large testaceous discal area, close to suture and about half as wide as elytra, narrowed posteriorly, extending from base to one-seventh from apex, leaving a narrow

sutural and wide marginal black stripe, palpi, tibial spurs, and tarsal claws partly reddish brown; body moderately clothed with a thin, pale golden pubescence, antennæ and hind tarsi nearly naked.

Head practically as broad as prothorax at base, slightly longer than broad, densely and minutely punctured; eyes moderate, rounded oval; vertex broad, slightly concave and finely grooved midlongitudinally; frons broader than long; clypeus trapeziform; labrum twice as broad as long; last segment of maxillary palpi subcylindrical, at least three times as long as broad; genæ slightly broader than long. Antennæ (female) about two-thirds as long as body, the posterior segments slightly thickened (last three missing); scape subcylindrical; second segment slightly longer than broad; third segment half again as long as first; fourth three-fourths as long as third; fifth slightly longer than fourth; sixth to eighth subequal, shorter than scape. Prothorax four-fifths as broad as elytra, slightly longer than breadth at base; base very slightly expanded; middle slightly swollen; apex narrowed but not transversely grooved or collared; surface finely punctured. Scutellum subequilaterally triangular, slightly rounded posteriorly. Elytra slightly abbreviated, not reaching apex of abdomen, slightly narrowed posteriorly, but not strongly constricted, one-half as broad near apex as at base; apices narrowed and obliquely truncated, subacuminate externally; surface sparsely and finely punctured. Abdomen as broad and as deep as thorax, the middle segments twice as broad as long. Hind legs long, tarsus longer than tibiæ, the first segment slightly shorter than following united, second segment subequal to remaining and double the third. Length, 12.4 millimeters (elytra, 7); breadth, 2.7.

Holotype, female, a unique, in the author's collection, taken by the author at Bukai, central Formosa, altitude 1,250 meters June 14, 1934.

Similar to *S. lineigera* (Fairmaire) and *S. angustissima* Gressitt, but shorter, with the elytra less constricted and attenuated posteriorly. The elytral marking consists of a large pale testaceous discal area and the rest of the body is black.

STRANGALINA SUBAPICALIS Gressitt sp. nov.

Subelongate, narrowed posteriorly; black, antennæ with ninth and tenth, apex of eighth, and base of last segment whitish testaceous, elytra pale castaneous with a narrow longitudinal discal stripe, commencing near base and ending in a union with

a marginal spot before apex, which continues externally around apex to suture, two marginal spots, one behind humerus, the other before middle, and the suture and external margin, narrowly, of black, fore and middle femora, basal third of hind pair and fore tibiae internally orange-testaceous; ventral surface of body and pronotum apically and basally, particularly on external angles, clothed with a dense, closely adpressed, golden pubescence, which hides the surface.

Head nearly as broad as prothorax at base, longer than broad, narrowed and subelongated anterior to eyes, transversely constricted at base of eyes; occiput parallel-sided, densely punctate, as are other parts of head except apex of frons; vertex narrow, acutely raised at each side between antennal insertions, narrowly concave in middle; frons nearly square; labrum very short, with an apical fringe; last segment of maxillary palpi somewhat swollen in middle, less than three times as long as broad, transversely truncated apically; eyes nearly round; genæ squarish. Antennæ (female) slightly longer than body, the segments thickened in posterior half, scape thickened towards apex; second segment longer than broad; third one-third again as long as scape; fourth subequal to scape; fifth subequal to third; sixth and following gradually slightly shorter; last equal to fifth. Prothorax four-fifths as broad as elytra, slightly longer than broad; narrowed anteriorly; sides nearly straight, hardly swollen in middle, very slightly expanded basally; constricted before the apex, with a slightly expanded collar; surface minutely punctured at sides, with deeper and sparser punctures above and a midlongitudinal impunctate stripe. Scutellum narrowly triangular. Elytra slightly abbreviated, evenly narrowed to near apex, not strongly constricted in middle, narrowed and subobliquely truncated at apices; surface moderately strongly punctured basally, more finely so posteriorly. Abdomen broad, the middle segments twice as broad as long. Hind legs with the femora reaching beyond elytral apices, the tarsi shorter than the tibiae, with the first segment subequal to the following united, and the second shorter than the remaining united. Length, 12 millimeters (elytra, 6.7); breadth, 2.75.

Holotype, female, a unique, in the author's collection, taken by the author at Hassenzan, north-central Formosa, altitude 2,250 meters, June 27, 1934.

Very closely related to *S. nymphula* (Bates), of Japan, and *S. lineigera* (Fairmaire), of China, but the prothorax less con-

stricted apically and the elytra more narrowly truncated apically and more abbreviated than in both.

MOLORCHINI

Genus *LEPTEPANIA* Heller, 1924

LEPTEPANIA MINUTA Gressitt sp. nov.

Very narrow, parallel, dorsoventrally compressed; prothorax with a large concavity at each side; subglabrous; shiny dark chestnut, nearly black on the pronotum, elytra very dark brown with a transverse, antemedian band of pale straw color, which forms an irregularly triangular spot on each elytron, the spot of each side with its base at the middle and its apex near the base of the elytron; prothorax, legs and antennæ internally clothed rather sparsely with moderately long, erect brown hairs, the swollen portions of femora glabrous, head and elytra clothed with shorter hairs, abdomen glabrous with a few straggling setæ at margin and apex; head and prothorax punctured with broad, shallow, variolate punctures, which are reticulated, elytra with a few irregular moderately deep punctures, ventral surface glabrous, with a few punctures on sides of thorax and basal abdominal segments.

Head very short, as broad as elytra and practically as broad as the broadest portion of prothorax and abdomen, very slightly constricted behind eyes; neck broad; occiput short; vertex level in middle, slightly swollen at sides near antennal tubercles which are very low and somewhat directed laterally; eyes small, divided, with the ventral lobe lateral, subcircular and hemispherical, the dorsal lobe apart, behind antennal tubercles and very narrow; frons convex, broader than long, narrower at apex than base; clypeus small, apical margin indented; labrum very small, exposing mandibles; genæ moderate, their front angles prominent; palpi minute, the apical segments subfusiform. Antennæ reaching to last fifth of body; the segments swollen, but mostly slightly compressed laterally and punctured on the sides; scape subpyriform, straight, internally; second segment longer than broad; third segment slightly longer than scape and subequal to fifth and sixth; fourth shorter than seventh and longer than eighth; ninth and tenth successively shorter; eleventh subequal to seventh, fusiform and acute. Prothorax much longer than broad, broader than elytra, broadest near base, apex nearly as broad, constricted to a narrow basal collar, which is three-fourths as broad as elytra, parallel-sided from above for an-

terior three-fifths; lateral concavities fringed internally with pale hairs. Scutellum minute, triangular. Elytra narrow, parallel-sided; slightly more than one-third as long as abdomen; rounded apically, slightly concave dorsally. Abdomen long, dorsally compressed, broadest behind middle, pleura with an oval depression on each segment. Legs short, fine; femora very strongly clavate for more than their apical halves, the swollen parts laterally compressed. Tarsi with the first segment of anterior pair very broad, with a spreading fringe of bristles, the third segment less so; middle and hind pair with the first segment normal and equal in length to the following two segments, the third segment dilated and fringed. Length, 3.75 millimeters; breadth, 0.6.

Holotype, probably a male, a unique, in the author's collection, taken at Hassenzan, Formosa, altitude 1,200 meters, June 20, 1932, by the author.

Very similar to the genotype, *L. longicollis* Heller,¹ of Luzon, differing principally in size and coloration, the proportions of the prothorax also being slightly different.

JAPANESE NAMES OF NEW SPECIES

1. *Pseudopidonia ænipennis* sp. nov. Aobane-yamanohana-kamikiri.
2. *Pseudopidonia subæneus* sp. nov. Ko-yamanohana-kamikiri.
3. *Pseudopidonia occipitalis* sp. nov. Taiwan-sesujihana-kamikiri.
4. *Leptura* (?) *ochraceoventra* sp. nov. Kibara-hana-kamikiri.
5. *Anoplodera* (?) *tricolor* sp. nov. Aobane-hana-kamikiri.
6. *Anoplodermorpha binotata* sp. nov. Futahoshi-chibi-hana-kamikiri.
7. *Anoplodermorpha breva* sp. nov. Ruribane-chibi-hana-kamikiri.
8. *Strangalina angustissima* sp. nov. Taiwan-hoso-hana-kamikiri.
9. *Strangalina suturalis* sp. nov. Sesuji-hoso-hana-kamikiri.
10. *Strangalina subapicalis* sp. nov. Atomon-hoso-hana-kamikiri.
11. *Leptepania minuta* sp. nov. Chibi-kobane-kamikiri.

¹ Philip. Journ. Sci. 10 (1915) 35.

NEW LONGICORN BEETLES FROM THE PHILIPPINES BORNEO, AND SIAM (COLEOPTERA: CERAMBYCIDÆ)

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The present paper deals with nine new species and three new genera of the subfamilies Disteniinæ, Lepturinæ, and Lamiinæ. Of the Disteniinæ are described a new *Distenia* from Siam and a new *Noemia* from Mindanao, of the Lepturinæ a new *Ocalemia* from Luzon and four new species of one new genus and one new species of another genus from British North Borneo, and of the Lamiinæ is described a new species of a new genus of the tribe Atossini from Siam.

For all the material herein described the author is greatly indebted to Mr. W. S. Fisher, of the United States National Museum, who kindly loaned this material for study. Most of the species described as new in this paper are from the C. F. Baker collection. All the types are preserved in the United States National Museum, Washington, D. C.

DISTENIINI

Genus *DISTENIA* Serville, 1825

DISTENIA FULVIPENNIS Gressitt sp. nov.

Elongate, narrowed posteriorly; brown, the head and prothorax nearly black, abdomen dull brown, first three antennal segments, mouth parts, except portions of mandibles, and legs dull reddish brown, lighter on tibiæ and tarsi, elytra and fourth to last antennal segments fulvo-testaceous, posterior margins of first, second, and fourth abdominal segments narrowly yellowish; entire body clothed with fine, tawny pubescence, thickest on breast; scape, head, and prothorax with a very few fine erect hairs; third to last antennal segments clothed internally with a few very long hairs, recumbent in the type specimen.

Head slightly longer than broad, but slightly narrowed behind eyes, very finely grooved medially from base to apex of vertex; eyes twice as high as wide, broader below than above, concave

anteriorly; vertex rounded-concave above and anteriorly; mandibles small; maxillary palpi fairly large, the last segment strongly thickened in middle internally, subtriangular (male). Antennæ slightly more than half again as long as body; scape thickened in posterior half, pedunculate, bent and slightly flattened basally, surface minutely granulose punctate; second segment broader than long; third segment longer than scape, equal to fourth; the following gradually shorter. Prothorax broader than long, moderately constricted near base and apex, strongly armed at each side with a broad-based, slightly upward directed, subacute tubercle; disc transversely impressed before and behind and furnished at each side with three blunt tubercles, two before and one behind, also with a slightly raised narrow middle area; surface very minutely punctate as is dorsal part of head. Scutellum as long as broad, rounded behind. Elytra narrowed posteriorly, straight-sided; apices narrowed and bidentate, the sutural tooth longer; disc with two weak longitudinal ridges, the outer one continuing to near apex, the inner one only perceptible near base, and five rows of deep punctures, extending to about middle, one subsutural, one submarginal, one bordering externally each of the two ridges and the other extending posteriorly from humerus; entire surface extremely minutely punctulate and marked with microscopic dark dots. Legs moderate; femora slightly swollen, the hind pair not reaching elytral apices; hind tarsus with the first segment shorter than the following segments combined. Length, 19.5 millimeters; breadth, 4.

Holotype, male, a unique (No. 51007, United States National Museum), Chiangmai, Siam, April 7, 1928, Dr. and Mrs. J. W. McKean.

Differs from *D. gracilis* Blessig, of Japan and Amur, in the elytra being furnished with five definite rows of strong punctures on basal half and in having the elytra, most of the antennæ, and part of the legs very light tan. Apparently related to *D. dohertii* Gahan, of India, but the latter has four, instead of five, rows of punctures, and has some punctures between the rows and at the apices of elytra; the coloration is also slightly different.

Genus NOEMIA Pascoe, 1857

NOEMIA MINDANAOENSIS Gressitt sp. nov.

Fine, elongate, slightly narrowed posteriorly; dull brown, head and prothorax shiny black with the exception of the mouth parts which are brown, antennæ tawny brown, the segments darker at apices, elytra brown with a somewhat greenish tinge,

legs reddish brown, the bases of femora pale testaceous; body thinly clothed with fine, erect hairs of moderate length, antennæ with very long, fine hairs internally, generally decumbent and not easily seen, body also clothed with a very fine silvery pubescence, particularly noticeable on underside of body and on prothorax at apex, base, and sides, the disc of pronotum nearly glabrous with a very few shallow scattered punctures near base.

Head considerably longer than broad, moderately narrowed behind eyes and strongly constricted before them; occiput with a fine, low carina, which hardly reaches vertex or neck; eyes lateral, subreniform, much higher than long, finely faceted; vertex moderately broad, slightly concave, abruptly declivitous anteriorly; clypeus and labrum broad, with their apical margins straight. Antennæ one and three-fourths times as long as body; scape pedunculate, and cylindrically swollen after first third; second segment as broad as long; third segment slightly shorter than fourth; following nearly equal in length. Prothorax slightly longer than broad, slightly narrower at apex than base, bluntly swollen at each side in middle, constricted before and behind middle. Scutellum minute, bluntly triangular. Elytra long, parallel, deeply punctured in about nine longitudinal rows; apices narrowed and rounded. Legs fine; femora slightly swollen; tarsi very short, first segment of hind pair shorter than the following two segments united. Length, 9 to 10 millimeters; breadth, 1.7.

Holotype female (No. 51006, United States National Museum), allotopotype, male, and paratopotype, male (U. S. Nat. Mus.) and paratopotype, male (author's collection), Zamboanga, Mindanao, Baker collection; paratype, female, Silipon, Bukidnon, Mindanao, collected by Philips, in the author's collection.

This species differs from *Noemia negrosensis* Aurivillius in having brownish antennæ, from *Noemia sibuyanensis* Aurivillius in lacking any elytral spots, from *Nericonia fuscicornis* Aurivillius in lacking silvery bands, and from *Nericonia opacella* Aurivillius in having the elytra greenish coppery brown, instead of black. The present species was ticketed as being identified as a *Nericonia* by Aurivillius, but is distinctly not of that genus. The specimen from Silipon in my collection has the elytra greener, the scape yellower, and the rest of the antennæ darker.

LEPTURINI

Genus *STENOLEPTURA* Gressitt novum

Head very broad, shortened anteriorly, dorsoventrally compressed, fairly plane above; vertex hardly swollen at sides; oc-

ciput very broad; eyes more or less kidney-shaped, closer anteriorly than posteriorly; maxillary palpi fusiform, thickest near base, bluntly pointed apically. Antennæ shorter than body, the posterior segments slightly thickened, but cylindrical, not broadened at apices. Prothorax strongly narrowed anteriorly, very broad basally, the angles covering fronts of humeri, nearly as broad as the base of elytra; sides nearly straight, hardly constricted near base; basal margin fairly strongly produced posteriorly at middle. Scutellum more or less an equilateral triangle. Elytra not strongly narrowed posteriorly, nearly parallel for their posterior two-thirds; apices obliquely truncate and strongly acuminate externally, the internal angles obsolete. Fore coxæ broad basally and narrowed apically. Hind tarsi very long, strongly compressed laterally, the first segment longer than following, second segment longer than remaining, at least three times as long as third and nearly twice as long as last.

Genotype.—*Stenoleptura sandakanus* Gressitt sp. nov.

Range.—British North Borneo (Sandakan).

This genus is closely related to *Strangalina* Aurivillius, but differs in its smaller size, and in being narrower at shoulders and less narrowed posteriorly. The head is very short and broad and dorsoventrally compressed, not declivitous from the vertex; the antennæ are shorter and thicker; the second segment of the hind tarsus is longer. The prothorax is very broad basally with the angles covering anterior portion of humeri and the middle produced over base of scutellum; it is not constricted before the apex or swollen in the middle. The second segment of the hind tarsus is at least three times as long as the following segment and nearly twice as long as the last segment.

STENOLEPTURA SANDAKANUS Gressitt sp. nov.

Minute, laterally compressed, moderately narrowed posteriorly; black, each elytron with a basal ochraceous spot extending from margin over humerus to scutellum and continuing posteriorly as a narrow discal line to three-fifths from base, approaching rather close to suture, head reddish brown on sides of frons, genæ, apical portions of clypeus and labrum and palpi, occipital angles testaceous, antennæ dark brown, the first two segments and bases of fourth and fifth segments dull reddish brown, the last four segments lighter brown, coxæ, bases of femora and tarsi except first segment of each pair dull testaceous; antennæ and body densely clothed with pubescence, head and prothorax rather sparsely clothed, that on elytra subreclining and giving a golden

brown effect, that on underside fine and dense, closely adpressed, and somewhat silvery.

Head strongly flattened and broadened, subabbreviated anteriorly; neck constricted close behind eyes, punctate; eyes large, reniform, emarginate internally at middle, distant; occiput very wide, vertex but slightly concave; frons nearly twice as broad as long; clypeus broader than long, narrowed apically, punctate; labrum more than twice as broad as long, punctate; mandibles moderately long; maxillary palpi long, the last segment oval and narrowly truncated apically; genæ very short, punctate. Antennæ inserted rather distantly and before middle of eyes, four-fifths as long as the body (female); scape narrow, cylindrical; second segment barely longer than broad; third longer than scape; fourth subequal to scape and fifth; sixth and seventh subequal; eighth, ninth, and eleventh subequal; tenth shorter; seventh to tenth segments cylindrical. Prothorax broader than long, strongly narrowed anteriorly; base practically as broad as shoulders, its angles hardly dilated; apex slightly more than half as broad as base; sides almost straight; anterior portion of disc narrowly swollen and moderately steeply inclined anteriorly; basal margin bisinuate; surface fairly deeply punctured at sides, less so above. Scutellum triangular, longer than broad. Elytra very narrow, but slightly narrowed beyond basal third; apices obliquely emarginate-truncate, the external angles strongly acuminate, the internal barely toothed; surface minutely and fairly evenly punctured throughout. Ventral surface minutely punctulate; fore coxæ rather broad basally; abdominal segments progressively shorter. Legs long, the hind pair extremely so; tibiæ slightly, and tarsi strongly compressed laterally; hind tarsus as long as tibiæ, first segment longer than following combined, second longer than remaining combined and over three times as long as third, which is no broader than the preceding. Length, 8.4 millimeters; breadth, 1.7.

Holotype, female, a unique (No. 51008, United States National Museum), Sandakan, British North Borneo, Baker collection.

Similar in markings to *longitarsis* Gressitt, but larger.

STENOLEPTURA RUFOANTICUS Gressitt sp. nov.

Very narrow, shoulders not expanded, slightly narrowed behind; largely reddish orange anteriorly and mostly blackish behind, head orange with the exception of eyes, apices of mandibles, and apical maxillary segments, which are blackish, antennæ with the first two segments black, reddish externally at bases

and apices (following segments missing), prothorax and scutellum entirely reddish orange, each elytron black with an ochraceous-orange area which covers the base, including humerus, and continues along the suture, gradually narrowing, to slightly beyond middle and an ochraceous apical area, slightly longer than broad, which covers the apex except for edges, ventral surface with ground color largely orange on thorax and black on abdomen, legs with the coxæ, basal portion of femora, and last four tarsal segments ochraceous, the remainder black, anterior femora largely pitchy, apical portion of first segment of hind femora dull ochraceous; body largely clothed with dense golden pubescence, giving a golden appearance to abdomen and posterior portion of elytra near suture, the pubescence black on sides of elytra and black portions of legs.

Head dorsoventrally compressed, slightly longer than broad, transversely constricted slightly behind eyes; eyes small, but moderately swollen, subreniform, distant; vertex slightly sulcate; last segment of maxillary palpi subfusiform, blunt at apex, hardly more than twice as long as broad; genæ moderate. Prothorax longer than broad; base practically as broad as elytra at base; apex slightly constricted, three-fourths as broad as base before constriction; sides straight; disc very slightly swollen; surface microscopically punctulate. Scutellum triangular, slightly longer than broad. Elytra long, straight-sided, slightly narrowed; apices narrowed and strongly obliquely truncated, acuminate externally. Abdomen with segments gradually diminishing in length. Hind legs with the femora nearly reaching elytral apices; tarsi barely longer than tibiæ, strongly compressed, first segment one-third again as long as following united, second over half again as long as remaining united. Length, 10.6 millimeters; breadth, 1.9.

Holotype, female, a unique (No. 51009, United States National Museum), Sandakan, British North Borneo, Baker collection.

Differs from *flavovittata* Aurivillius (described as a *Strangalia*, and apparently a *Stenoleptura*), in having the head, prothorax, and chest entirely reddish orange, instead of largely black; the elytral stripe extends but slightly beyond middle and is not dilated posteriorly.

STENOLEPTURA PRODUCTICOLLIS Gressitt sp. nov.

Narrow, head as broad as elytra, elytra narrowed behind base; black, the antennæ blackish brown, bases of segments paler, elytra with a bracketlike testaceous marking on each side forming a zerolike marking, subrounded internally, quadrilateral

externally, longer than broad, broader anteriorly than posteriorly, front and back sides wider than lateral sides, interrupted only at scutellum and suture, not touching external margin, external portion of bases of hind femora slightly pale, last four tarsal segments of each pair and posterior portion of hind tarsi ochraceous; body fairly densely clothed with fine pale pubescence, giving a silvery effect to abdomen, antennæ with short black hairs at apices of segments, particularly third to fifth.

Head as broad as long, nearly as broad as elytra at base, dorsoventrally compressed; neck emarginately constricted behind eyes; eyes fairly large and long, subreniform, more distant behind than before; preocular portion much abbreviated; clypeus punctured; maxillary palpi with the second and third segments thickened apically, the last segment thickest near base and acutely attenuated apically; genæ very short. Antennæ about three-fourths as long as body; scape almost straight, subcylindrical; second segment practically as broad as long; third segment one-third longer than scape; following segments subequal to third, gradually decreasing (last two missing). Prothorax longer than broad, narrowed anteriorly, constricted at apex above; base practically as broad as elytra; sides nearly straight; disc strongly and narrowly swollen anteriorly, abruptly declivitous at apex. Scutellum subequilaterally triangular. Elytra narrowed at end of basal quarter, subparallel from there to near apex; apices narrow, strongly obliquely truncated, produced acuminate externally; surface minutely punctulate. Hind legs considerably longer than body; first segment of hind tarsi longer than following united, second segment three times as long as third segment, nearly twice as long as last. Length, 7.6 millimeters; breadth 1.6.

Holotype, male, a unique (No. 51010, United States National Museum), Sandakan, British North Borneo, Baker collection.

Quite distinct from the other members of the genus with its anteriorly and narrowly produced disc of pronotum and the prominent anterior zerolike circle and posterior rounded spot of testaceous on elytra.

STENOLEPTURA LONGITARSUS Gressitt sp. nov.

Minute, shoulders narrow, but slightly narrowed posteriorly; black, antennæ with the last segment dull ochraceous, the preceding brownish black, elytra light castaneous, becoming pitchy behind the middle and black towards apices, forelegs with the femora dull ochraceous and the remainder dull brown, middle and hind tarsi and the abdomen posteriorly slightly pitchy brown;

elytra fairly densely clothed with subreclining golden hairs, ventral surface and prothorax moderately densely clothed with fine pale golden pubescence, legs somewhat more coarsely clothed, antennæ with short black hairs at sides of apices of segments, particularly the third to eighth.

Head much abbreviated anteriorly, swollen laterally, as broad as long; preocular portion but half as long as basal portion; neck constricted almost immediately behind eyes; eyes large, broad anteriorly, more distant behind than before, narrowly emarginate internally; vertex fairly even; frons short and strongly narrowed apically; clypeus and labrum very small; genæ almost obsolete. Antennæ three-fourths as long as the body (male); the posterior segments thickened and cylindrical, the tenth barely twice as long as thick; scape short, thickened towards apex; second segment hardly longer than broad; third segment slightly longer than scape; fourth slightly shorter than third, equal to fifth; fifth to tenth gradually shorter; eleventh equal to sixth. Prothorax slightly longer than broad, narrowed anteriorly, slightly constricted at apex; base as broad as shoulders, produced over base of scutellum, the angles covering front of humeri; sides nearly straight; disc moderately swollen, slightly laterally compressed anteriorly; surface minutely granulose punctate. Scutellum subequilaterally triangular. Elytra nearly parallel, but slightly narrowed beyond basal third; apices obliquely slightly emarginate-truncate, acuminate produced externally; surface moderately punctured. Hind legs with the tarsi considerably longer than tibiæ, the first segment slightly longer than the following united, the second segment nearly half again as long as the remainder united. Length, 5.5 millimeters; breadth, 1.2.

Holotype, male, a unique (No. 51011, United States National Museum), Sandakan, British North Borneo, Baker collection.

Distinguished from the other members of the genus by its strikingly broad, short, and anteriorly abbreviated head. The markings are somewhat similar to those in *sandakanus* Gressitt.

Genus ACANTHOLEPTURA Gressitt novum

Narrow, subabbreviated anteriorly, laterally compressed. Head nearly twice as long as broad, nearly as broad as prothorax at base; eyes moderately swollen, subreniform, very minutely faceted; neck constricted immediately at base of eyes; vertex with the antennal insertions very close and narrowly concave between them; frons higher than wide, the apical triangular area punctured deeply like rest of head; genæ very long; last segment of

maxillary palpi three times as long as broad, thickest near base, subobliquely truncated apically. Antennæ nearly one-third longer than the body in the male and subequal to the body in the female; the posterior segments cylindrical; second segment longer than broad; third subequal to scape, barely longer than fourth and but three-fourths as long as fifth; fifth to tenth gradually shorter; last one-third longer than fifth. Prothorax narrow, three-fifths as broad as elytra, hardly swollen at sides, fairly strongly swollen above, not expanded at base, nearly straight-sided, rather widely constricted before apex, with a very slightly dilated apical collar; disc and sides glabrous, nearly impunctate; each side with an oblique constriction near base. Scutellum minute and narrow. Elytra two and one-half times as long as breadth at base, straight-sided, wedge-shaped, not constricted, more than half as broad as base before last fifth; apices obliquely emarginate truncate with the external angles produced into a strong acute spine; surface shiny, but with large punctures. Fore coxæ narrowed apically, approximate; mesosternal intercoxal process moderately narrow; metepisternum largely glabrous, impunctate and highly polished. Middle femora fairly strongly swollen before apices; hind legs not exceedingly long, the tarsi hardly as long as the tibiæ, with the first segment slightly longer than the following united, the second segment shorter than the remaining and less than twice as long as the third, the first laterally compressed, apparently not grooved below, but very hairy, the second and third dorsoventrally compressed and padded beneath.

Genotype.—*Acantholeptura glabropleura* Gressitt sp. nov.

Range.—British North Borneo (Sandakan).

This genus is related to *Eustrangalis* Bates, *Strangalina* Aurivillius, and *Ocalemia* Pascoe, but differs from all of them in having the third antennal segment shorter than the fifth and no longer than scape, the metepisternum parallel-sided for most of its length and the elytra rather short and not strongly narrowed as in the latter two. It agrees with *Eustrangalis* in having the elytra spined externally at apices and the second tarsal segment flattened, but differs in having the last maxillary palpal segment longer and the prothorax not strongly constricted behind the swollen middle, besides the aforementioned characters.

ACANTHOLEPTURA GLABROPLEURA Gressitt sp. nov.

Rather abbreviated posteriorly, not strongly narrowed; black, antennæ with the apex of the eighth, the ninth, and more than

half of the tenth segment testaceous, palpi and femora, except apices of anterior and middle pairs and apical third of hind pair, reddish brown, each elytron marked with reddish brown spots, except for the large apical spot which is testaceous, as follows: Two longitudinal discal stripes from base to end of first quarter, the inner one longer and expanded towards suture in middle, side with an oblong spot below humeral angle, a narrow submarginal spot one-third from base, just behind middle, which extends internally and slightly obliquely anteriorly as an incomplete fascia to midline of elytron, a free subapical testaceous spot which is hardly longer than broad, apical margins of first four abdominal segments testaceous brown; head with a few pale long erect hairs, antennæ with a few short black bristles on underside of third to fifth segments and at apices of following ones, elytra sparsely clothed with obliquely inclined reddish bristles, one from each puncture, remainder of body clothed with a dense silvery brown pubescence except for pronotum which is nearly glabrous except near base and lateral posterior portions of abdominal segments; head minutely punctured, prothorax nearly impunctate, elytra fairly strongly, but not densely punctured, more finely towards apices, ventral surface impunctate.

Head elongate; eyes swollen and moderately prominent, egg-shaped, slightly indented internally; neck constricted immediately behind eyes; occiput with a carina in center; vertex sulcate; antennal tubercles very close, placed slightly behind anterior margin of eyes; frons somewhat squarish, impunctate only in center; labrum twice as broad as long; mandibles long; genæ long and parallel; last segment of maxillary palpi more than twice as long as broad and obliquely truncated apically. Antennæ one-fourth longer than body in male, the segments not expanded at apices; scape short, curved, punctate; second segment longer than broad; third slightly longer and fourth slightly shorter than scape; fifth slightly longer than third; following subequal, the last double the fourth. Prothorax nearly half again as long as broad, constricted before apex; sides obliquely constricted near base; base bisinuate, the angles not dilated. Scutellum narrow, rounded apically. Elytra only slightly longer than head and prothorax united, wedge-shaped, not constricted in middle; apices narrowed internally and obliquely emarginate-truncate, the external angles strongly acuminate. Hind legs fairly long, tibiæ and tarsi compressed, the tarsi not quite as long as the tibiæ; first tarsal segment longer than following

united, the second shorter than the remaining. Length, 11.5 to 12.5 millimeters; breadth, 2.6 to 3.

Holotype, male (No. 51013, United States National Museum), and allotopotype female (U. S. Nat. Mus.), and a paratopotype, male, in the author's collection; Sandakan, British North Borneo, Baker collection.

Genus *OCALEMIA* Pascoe, 1858

OCALEMIA *ANGUSTOLINEATA* Gressitt sp. nov.

Elongate, strongly narrowed behind; black, sixth to eighth antennal segments (last three missing) largely testaceous, darker at apices and inner sides, each elytron with a minute reddish brown spot on front of humerus and a testaceous discal stripe extending two-thirds of elytral length, broadened near base and very narrow for remainder of its length and gradually becoming closer to, but not touching the suture, remainder of the elytra with a very slight tinge of metallic green, scutellum and ventral surface of body fairly densely clothed with tawny white pubescence; head and pronotum more sparsely clothed, the latter more densely near base; antennæ with a few short black hairs at apices of segments and on underside of basal segments.

Head nearly twice as long as broad, portion anterior to eyes excluding mandibles broader than long, eyes subglobular and greatly swollen, very minutely faceted, slightly indented internally; neck constricted immediately behind eyes; occiput broad; vertex concave in middle and swollen at each side between antennal insertions, which are close and placed near anterior border of eyes; frons longer than broad; labrum nearly as long as broad; last palpal segment subobliquely truncate apically; surface minutely punctulate except on triangular shiny area of frons. Antennæ not quite as long as the body (male), the segments very slightly dilated apically; scape slightly arched; second segment as long as broad; third two-thirds again as long as scape; fourth two-thirds as long as third; fifth nearly as long as third; sixth to eighth subequal and slightly shorter than fifth. Prothorax longer than broad, subcampanulate, constricted before apex; basal margin bisinuate, the external angles hardly produced; surface minutely punctulate. Scutellum triangular, longer than broad. Elytra elongate, strongly narrowed beyond basal third, narrowest in second third except for apex; apex obliquely truncate, produced externally, but not dentate; surface fairly strongly punctate on basal half, less so apically. Abdomen very fine, the first four segments subequal, the last shorter and

slightly concave below. Legs with the femora slightly swollen, the hind pair long, the tibiæ at apices and the tarsi laterally compressed, the latter longer than the tibiæ, the first segment longer than the rest combined, and the second longer than the remaining combined. Length, 14 millimeters; breadth, 3.

Holotype, male, a unique (No. 51012, United States National Museum), Lamac, Bataan Province, Luzon, between March and June, 1911, by C. V. Piper.

Similar in structure to *O. prasina* Heller, except that the prothorax is less swollen at sides and the elytra are more narrowed; very different in coloration, the latter being metallic green, with the femora red and only the apical antennal segments pale.

ATOSSINI

Genus *PARAPHEMONE* Gressitt novum

Subcylindrical, parallel-sided; head directed posteriorly below; frons rectangular, nearly half again as high as wide, marked with a median slightly raised line, separated from the clypeus by a transverse swollen ridge; vertex very slightly concave between antennal tubercles, which are almost obsolete; occiput even, marked with a very narrow longitudinal line; clypeus fairly large and strongly narrowed toward apex; labrum two-thirds as long as broad, longer than clypeus; mandibles nearly straight-sided; longitudinally sulcate basally; palpi with the last segment of each pair fusiform and equal in length; genæ very high, each with an oblique transverse costa not reaching frons; eyes very small, lobes separated into two divisions connected by a fine thread, dorsal lobe narrowly oval, ventral lobe shorter than broad, nearly round. Antennæ (female ?) as long as the body, first four segments thick, together as long as the remaining segments, which are very fine; scape cylindrical, reaching to middle of prothorax, noncicatricized; second segment half as long as broad; third segment cylindrical, one-fourth longer than scape; fourth segment two-thirds as long as third, longer than fifth, thickest in middle, narrow at apex, nearly fusiform; fifth and succeeding segments very much finer than preceding ones, successively shorter and finer towards apex. Prothorax barely broader than long, slightly narrowed towards apex, base four-fifths as broad as elytra, posterior margin slightly concave on each side of middle, sides hardly swollen, dorsal surface subvermiculose and punctate at sides. Scutellum broader than long, rounded. Elytra parallel, rounded apically, marked with several feebly swollen costæ which are more noticeable behind

middle and interspersed with punctures, which are closer on disc. Ventral surface impunctate; fore coxæ globular and very prominent, but not higher than intercoxal process which is vertical behind and subvertical in front; middle coxal cavities open externally; intercoxal process of mesosternum broad, projecting slightly anteriorly; last abdominal segment longer than the preceding two united, last tergum indented. Legs robust; hind pair much shorter than fore pair, the hind femora reaching barely to middle of abdomen; femora fusiform; middle tibiæ not grooved; tarsi broad, strongly dilated in the first pair, the first segment barely as long as the third, second short; claws narrowly divergent.

Genotype.—*Paraphemone multimaculata* Gressitt.

Range.—Lower Siam.

Similar to *Phemone* Pascoe¹ in having the narrow form; elytra which very slightly exceed prothorax in breadth; and the broad anterior tarsi. It is separated, however, by the anomalous condition of the antennæ and the minutely divided eyes. The former have the basal four segments very thick, the fourth thicker than the third, with the remaining segments contrastingly very much finer and also shorter; the scape is shorter and thicker than in *Phemone*, and is as thick near base as at apex. The genus agrees with the tribal characters, except for the frons lacking the longitudinal ridges and the antennal condition being somewhat incongruous.

PARAPHEMONE MULTIMACULATA Gressitt sp. nov.

Black, clothed with a pile which is white, cinnamon or dark brown in parts; elytra with very many small irregular-shaped white spots arranged rather irregularly in six or seven longitudinal stripes; head with the lower portions, including genæ and apical two-thirds of frons dirty whitish cinnamon, the labrum darker, upper portions of head dark gray-brown with the exception of two longitudinal stripes of cinnamon at each side, one pair commencing on vertex between antennal insertions and becoming farther apart posteriorly, the other pair commencing behind antennal insertions; antennæ with the first three segments cinnamon, the fourth, except base, dark brown, the fifth and sixth dirty cinnamon basally with their apices and the remaining segments dull chestnut; prothorax grayish brown, nearly black, with a pair of longitudinal parallel cinnamon stripes at each side of dorsal surface, being the continuations

¹ Trans. Ent. Soc. London II 5 (1858-1861) 48, pl. 2, fig. 5.

of the cephalic stripes, portion below middle of sides clothed with dense white hairs; sides of meso- and metathorax and abdomen, except for a marginal triangle on each abdominal segment, similarly clothed with white; a fringe of longer hairs at apex and margin of abdomen; forelegs dirty cinnamon, the middle and hind pairs paler.

Head narrow, impunctate; frons high and parallel-sided; labrum large; eyes very small; antennæ as long as the body, the scape reaching to middle of prothorax, nearly as long as third; fourth two-thirds as long, remaining segments much shorter and finer; prothorax broader than long, cylindrical; disc not swollen, slightly transversely vermiculose, punctate laterally; scutellum short, rounded; elytra moderately well punctured, with about four low ridges extending posteriorly slightly obliquely towards suture, apices rounded externally; ventral surface impunctate; prosternal intercoxal process as high as coxæ, which are very prominent, mesosternal process broad and directed slightly anteriorly, metasternum glabrous; forelegs longer and hind legs shorter than middle pair, hind femora as long as first three abdominal segments; fore tarsi very broad. Length, 13.25 millimeters; breadth, 4.25.

Holotype, female (?), a unique (No. 50902, United States National Museum); Trong, Lower Siam, W. L. Abbott.

A REVIEW OF PHILIPPINE MENIDÆ AND GERRIDÆ

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THREE PLATES

This paper contains a review of the families Menidæ and Gerridæ known to inhabit Philippine waters. The material used is in the collection of the fish and game administration, Bureau of Science, Manila.

MENIDÆ

Body strongly compressed, nearly triangular, with prominent, trenchant abdomen, covered with minute scales, not visible to the naked eye. Head small, mouth vertical and protractile; teeth villiform, none on palate. Preoperculum and operculum entire. Dorsal single, long, without distinct spinous portion; anal without spines, and with rays enveloped by skin, their free extremities very broad; ventral thoracic, with one spine and five soft rays, first ray very elongate. Branchiostegals seven.

This family is represented in the Philippines by one genus and one species.

Menidæ is closest to Lamprididæ, known as opah, moonfish, mariposa, or San Pedro fish. *Mene maculata* is a small fish, about a foot long, with compressed body. The fins are low and the belly, through the extension of the pelvic bone, is more prominent than the back. The ventral fins have one spine and five soft rays, a character which separates *Mene* widely from *Lampris*, which is allied to it.

MENE MACULATA (Bloch and Schneider). Plate 1, fig. 1.

Zeus maculatus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 95.

Mene anna carolina LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 479-480.

Mene maculata CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 104; GÜNTHER, Cat. Brit. Mus. 2 (1860) 415; DAY, Fishes of India 4.^o (1878-1888) 249; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 [1906] 1907] 15; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 251; McCULLOCH, Mem. Queensl. Mus. 7 (1922) 241; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 6 (1931) 308-309.

Dorsal IV, 40-42; anal 30-33; pectoral 15; ventral I, 5.

Depth 1.3; head 4; eye 3.33 in head; snout 1.66 in head. Body ovoid, deepest anteriorly. Upper profile nearly horizontal, lower nearly semicircular. Mouth vertical; intermaxillaries protractile, extending upwards when protruded; lower jaw slightly the longer; when protracted forming a tube directed horizontally, cleft twice as long as gape. Anterior portion of upper jaw formed by premaxillaries, the maxilla smooth, somewhat S-shaped and extending to below anterior edge of orbit. Preoperculum and operculum rounded and entire. Occipital crest high. Seven branchiostegals; gill opening wide, gill membranes not connected, free from isthmus. Teeth in villiform rows on jaws, none on palate. Dorsal fin highest anteriorly, anterior rays undivided and slightly more elevated than the remainder. Pectoral as long as head, excluding snout, rays flat; ventral spine short, its first ray compressed and very long. Anal rudimentary, its rays forming short, wide, and flat processes. Caudal deeply incised, with equal lobes. Lateral line terminates below end of dorsal fin. Color deep blue along back, becoming silvery white on sides and abdomen; from two to four irregular series of lead-colored rounded spots above and below lateral line; fins hyaline, dorsal, caudal, and ventral filaments dusky.

Small fish, at most a foot long, inhabiting shallow sandy places.

Habitat.—Sea of Penang, Singapore, Sumatra, Java, Celebes, Madagascar, British India, Ceylon, China, Japan, Formosa, Philippines, and Queensland.

The above description is based on No. 12478, 152 mm, from Rabon, La Union, July 24, 1925.

LUZON, Ilocos Sur Province, Vigan, No. 10210, 172 mm, February, 1923: Manila, No. 6756, 120 mm, September 15, 1911. SAMAR, Samar Province, Calbayog, Nos. 14870, 28195, 160 to 180 mm: NEGROS, Occidental Negros Province, Cadiz, Nos. 16248, 28196, 146 to 156 mm. MINDANAO, Agusan Province, Butuan Bay, No. 1907, 161 mm, September 25, 1907.

GERRIDÆ

Body compressed, back more or less elevated, form usually ovoid. Scales moderate, minutely ciliated or crenulated, present on occipital, frontal, and lateral parts of head. Lateral line complete and continuous, concurrent with profile of back. No ridges on top of head; an interorbital with a naked concavity for receiving maxillary process. Eyes rather large, lateral.

Mouth moderate, greatly protractile, extending downward when protruded. Maxillary without supplemental bone and not slipping below a very narrow preorbital; a slit between base of mandible and preorbital permits the free motion of maxillary. Teeth small, acute, none on vomer, palatines, or tongue. Six branchiostegals; four gills; pseudobranchiæ present, glandular; gill membranes free, not united at isthmus. Lower pharyngeal bones united by mobile suture or ligament, forming a more or less triangular osseous plate, covered with conical or subulate teeth. Dorsals and anals depressible into basal scaly sheaths. Dorsal fin single, continuous or deeply notched. Dorsal spines usually nine, sometimes ten. Anal with three spines and seven rays. Ventrals thoracic, with one spine and five rays, the fins rather close together and slightly behind pectorals. Pectorals long, pointed. Caudal deeply incised with fifteen branched rays.

Small or medium-sized fishes of the tropical and temperate seas, some entering mouths of rivers. More or less bright to brilliant silvery white; some may be marked with slightly darker longitudinal or transverse lines, bands, or blotches.

Found frequently in great numbers about sandy shallows, where they are said to spawn and feed. Most of the species are valued as food fishes.

This family is represented by one genus with seven species in the collection. *Gerres poeti* Cuvier and Valenciennes was reported by Fowler as being present in Philippine waters, but it has no example in our collection.

The taxonomic position of the family *Gerridæ* in relation to *Leiognathidæ* has been the subject of varying opinions. Bleeker treated *Equula* (*Leiognathus*) and *Gazza* under the *Carangidæ* and gave *Gerres* and *Pentaprion* as subfamily *Gerriformes* a place in what he named "Percoidei." Günther¹ placed the family *Gerridæ* in the "Acanthopterygii Pharyngognathi," and united *Equula* and *Gazza* with the *Carangidæ*, because the lower pharyngeal bones are firmly united by a suture. Jordan in his latest classification of fishes (1923) writes: "The resemblance of *Leiognathus* to *Gerres* seems to be superficial not indicating any special affinity." The author agrees with Jordan and, therefore, disagrees with Weber and de Beaufort² that *Leiognathidæ* should be separated from *Gerridæ*.

¹ Cat. Brit. Mus. 4 (1862) 252.

² The Fishes of the Indo-Australian Archipelago 6 (1931) 310.

Key to the Philippine species of *Gerres*.

- a*¹. Pectoral reaches opposite or beyond anal origin.
- b*¹. Distance of dorsal origin from end of snout equal to height of body.
- c*¹. Scales in lateral series 32 to 36; in transverse series 15; scales 5 to 7 from lateral line to dorsal origin; second dorsal spine 1.1 to 1.2 in head; depth of body 1.9 to 2.1.
Gerres abbreviatus Bleeker.
- c*². Scales in lateral series 40 to 45; in transverse series 18 to 20; scales 5 or 6 from lateral line to dorsal origin; second dorsal spine very much longer than head; depth of body 2.2 to 2.5.
Gerres filamentosus Cuvier.
- b*². Distance of dorsal origin from end of snout greater than height.
- c*¹. Scales in lateral series 36 to 40; second dorsal spine 1.3 to 1.7 in head.
- d*¹. Transverse series 15; scales 4 or 5 from lateral line to dorsal origin; depth of body 2.5 to 3..... *Gerres kapas* Bleeker.
- d*². Transverse series 16; scales 5 to 7 from lateral line to dorsal origin; depth of body 2.5 to 2.8..... *Gerres oyena* (Forskål).
- c*². Scales in lateral series 45 to 48; transverse series 17; scales 7 from lateral line to spinous dorsal origin; second dorsal spine 1.5 to 2 in head; depth of body 3.1.
Gerres oblongus Cuvier and Valenciennes.
- a*². Pectoral not reaching anal origin.
- b*¹. Scales in lateral series 40 to 42; transverse series 14 or 15; scales 5 from lateral line to dorsal origin; second dorsal spine 1.3 to 1.5 in head; depth 2.5; premaxillary groove completely scaled in front.
Gerres baconensis (Evermann and Seale).
- b*². Scales in lateral series 42 or 43; transverse series 17 or 18; scales 4.5 or 5 from lateral line to dorsal origin; second dorsal spine 1.5 to 1.7 in head; depth 3 to 3.1..... *Gerres macrosoma* Bleeker.

GERRES ABBREVIATUS Bleeker. Plate 1, fig. 2.

- Gerres abbreviatus* BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1850) 103; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 345; KNER, Reise Novara, Fische (1865) 56; DAY, Proc. Zool. Soc. London (1870) 698; Fish. Ind. 4^o. (1878-88) 99; MEYER, Anal. Soc. Española Hist. Nat., Madrid 14 (1885) 18; DAY, Fauna Brit. India, Fishes 2 (1889) 538; WEBER, Siboga-Exp. 57 (1913) 272; FOWLER, Proc. Acad. Nat. Sci. Phila. (1927) 284; FOWLER and BEAN, Proc. U. S. Nat. Mus. 71 Art. 10 (1927) 7; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 224.
- Diapterus abbreviatus* BLEEKER, Atlas Ichth. Ind. Neerland. 3 (1876-77) 127, pl. (78), fig. 4.
- Xystaema abbreviatum* JORDAN and SEALE, Bull. Bur. Fish. 25 [(1905) 1906] 272; JORDAN and RICHARDSON, Mem. Carnegie Mus. 4 (1909) 190.
- Xystaema abbreviatus* SEALE, Philip. Journ. Sci. § D 5 (1910) 278.
- Xystaema abbreviata* FOWLER, Copeia No. 53 (1918) 64.

Dorsal IX, 10; anal III, 7; scales in lateral line 32 to 36; transverse series 15.

Body oblong, anteriorly elevated, the dorsal profile ascending to about 45° from snout to dorsal fin, thence descending nearly straight to caudal peduncle. Height about 2 in length, head 3 to 3.10, pointed; interorbital 2.5 to 3, broadly convex to nearly level, is lightly smaller than eye, whose diameter is 2.7 to 3 in head and is longer than snout. Maxillary reaches opposite pupil; mandibular profile slightly concave. Lower pharyngeal bones coössified with a double median series of large molariform teeth in pavementlike arrangement. Preoperculum entire. Scales large, thin, with margin entire; three rows on cheek to preopercle ridge. Scales with five or six basal radiating striæ; circuli very fine. Dorsal origin to end of snout nearly equal to height of body; second dorsal spine 1.1 to 1.2 in head, first ray 2.1 to 2.5. Second anal spine 1.7 to 2, first ray 1.9 to 2.25, least depth of caudal peduncle 2.2 to 2.3, ventral 1.2 to 1.3; caudal 2 to 3.5 in body; pectorals much longer than head, 2.3 to 2.7 in body. Body silvery, bluish above with indistinct longitudinal darkish lines corresponding with the series of lateral scales. Fins pale, dorsal dusky gray terminally.

Habitat.—Queensland, India, East Indies, and Philippine Islands.

The above description is based on No. 15502, 190 mm, Guinlo, Palawan, June 1, 1927.

LUZON, Zambales Province, Subic, No. 15119, 177 mm, April 9, 1927: Manila, Manila Market, No. 165, 126 mm, June 14, 1907; No. 553, 26 to 33 mm, August, 1907: Batangas Province, Balayan Bay, Lemery, Nos. 24111, 13890, 24112, 4579, 80 to 97 mm, April 19, 1926: Tayabas Province, Polillo, No. 31251, 68 mm, April 5, 1928. MINDORO, Mindoro Province, Mangarin, No. 9649, 158 mm, 1913. ROMBLON, Romblon Province, Romblon, Nos. 11878, 24080, 65 to 93 mm, August 1, 1921. MASBATE, Masbate Province, Aroroy, Nos. 27634, 27636, 1059, 40 to 52 mm, August 30, 1907, Guinobatan, No. 1081, 47 mm, August 31, 1907. LEYTE, Leyte Province, Carigara, Nos. 14986, 14649, 24109, 24110, 74 to 84 mm, December 1, 1926. SAMAR, Samar Province, Calbayog, No. 14656, 170 mm, December 17, 1926. SQUIJOR, Oriental Negros Province, Lazi, No. 5299, 40 to 58 mm, September 6, 1909. PALAWAN, Palawan Province, Puerto Princesa, No. 1963, 86 mm, September 30, 1907; Puerto Princesa No. 12438, 141 mm, September 12, 1905; Panacan, Paragna, Nos. 5333, 27633, 45 to 59 mm, August 14, 1908; Canigaran, Nos. 24084, 24085, 12643, 51 to 95 mm, November, 1925. BALA-

BAC, Palawan Province, Balabac, No. 15773, 202 mm, November 17, 1926; No. 5113, 43 mm, August 6, 1908. MINDANAO, Cagayan Province, Cagayan, No. 1464, 91 mm, September 8, 1907; No. 1494, 45 mm, September 9, 1907; No. 1643, 55 mm, May 13, 1907: Zamboanga Province, Nos. 2949, 27635, 52 to 58 mm, April 10, 1908. SAMAL, Davao Province, No. 3507, 55 mm, April 29, 1908. TAWITAWI, Sulu Province, Buan, No. 10769, 240 mm, September 21, 1923; Nos. 24086, 24087, 11843, 67 to 79 mm, August 18, 1924. BILATAN, Sulu Province, No. 11354, 169 mm, July 29, 1924. BUNGAU, Sulu Province, No. 11923, 52 mm, September, 1923.

We have the following foreign example: BORNEO, Sandakan, No. 14143, 118 mm, November, 1925.

GERRES FILAMENTOSUS Cuvier. Plate 2, fig. 1.

Gerres filamentosus CUVIER, Regne Animal ed. 1 7 [1816 (1817)] 104; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 6 (1830) 363; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 345; KNER, Reise Novara, Fische (1865) 56; DAY, Fishes of Malabar (1865) 159; PETERS, Monatsb. Akad. Wiss. Berlin (1868) 257; DAY, Proc. Zool. Soc. London (1870) 698; Fishes of India pt. 1 (1875) 98, pl. 25, fig. 3; PETERS, Monatsb. Akad. Wiss. Berlin (1876) 487; DAY, Fauna Brit. India, Fishes 2 (1889) 537, fig. 163; FOWLER, Journ. Acad. Nat. Sci. Phila. II 12 (1904) 530; SNYDER, Proc. U. S. Nat. Mus. 42 (1912) 501; WEBER, Siboga-Exp. 57 (1913) 271; DE BEAUFORT, Bijd. Dierk. Amsterdam 19 (1913) 120; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 Art. 2 (1922) 42; FOWLER, Proc. Acad. Nat. Sci. Phila. (1923) 41; (1925) 244; Journ. Bombay Nat. Hist. Soc. 3 No. 4 (1926) 8; FOWLER and BEAN, Proc. U. S. Nat. Mus. 71 Art. 10 (1927) 7; FOWLER, Proc. Acad. Nat. Sci. Phila. (1927) 285; Journ. Bombay Nat. Hist. Soc. 33 No. 1 (1928) 115; Mem. B. P. Bishop Mus. 10 (1928) 226; Proc. Acad. Nat. Sci. Phila. [1929 (1930)] 610; FOWLER, Mem. B. P. Bishop Mus. 11 No. 5 (1931) 336.

Catochaenum filamentosus CANTOR, Journ. Asiat. Soc. Bengal 18 pt. 2 (1850) 1038, 1849.

Diapterus filamentosus BLEEKER, Ned. Tijdschr. Dierk. 4 (1873) 117; Atlas Ichth. Ind. Neerland. 8 (1876-77) 124, pl. 78, fig. 3.

Gerres punctatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 6 (1830) 480; BLEEKER, Natuur. Geneesk. Arch. Ned. Ind. 2 (1845) 521; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 345; DAY, Fishes of Malabar (1865) 159; SAUVAGE, Hist. Nat. Madagascar, Poiss. (1891) 246; CASTO DE ELERA, Cat. Fauna Filip. 1 (1895) 560.

Xystaema punctatum JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 782; Bull. U. S. Bur. Fish. 26 [1906 (1907)] 24; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 244; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 69; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 260; SEALE, Philip.

- Journ. Sci. § D 9 (1914) 67; JORDAN and STARKS, Ann. Carnegie Mus. 11 Nos. 3, 4 (1917) 455; FOWLER, Copeia No. 58 (1918) 64.
Gerres macracanthus BLEEKER, Tijdschr. Neder. Ind. 6 (1854) 195; GÜNTHER, Cat. Fish. Brit. Mus. 4 (1862) 261; DE BEAUFORT, Bijdr. Dierk., Amsterdam 19 (1913) 121.
Diapterus macracanthus BLEEKER, Atlas Ichth. Ind. Neerland. 8 (1876-77) 125, pl. (78) 362, fig. 1.
Sparus edentulus GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 346.
Xystaema macracantha FOWLER, Copeia No. 58 (1918) 64.
Gerres philippinus GÜNTHER, Cat. Fish. Brit. Mus. 4 (1862) 258; Ann. & Mag. Nat. Hist. III 20 (1867) 66; CASTO DE ELERA, Cat. Fauna Filip. 1 (1895) 560.
Diapterus philippinus BLEEKER, Versl. Meded. Akad. Wet. Amsterdam II 7 (1873) 242.

Dorsal IX, 10; anal III, 7; scales in lateral line 40; transverse series 18 or 19.

Body oblong, elevated, height 2.2 to 2.5; head pointed, 3 to 3.5. Snout 3 to 3.4 in head; eye 3, about equal to snout, 1 to 1.3 in interorbital space, somewhat more than pointed snout. Mandibular profile strongly concave. Maxillary surpasses front edge of eye. Interorbital 2.5 to 3, broadly convex. Gill rakers 4 + 7, lanceolate, a third of gill filaments, which is 2.5 in eye.

Scales 40 to 45 in lateral line to caudal base, and 3 to 5 more beyond; 20 to 22 predorsals, forward opposite front eye edge; three rows on cheek to preopercular ridge. Scales with six to ten basal radiating striæ; circuli extremely fine. Dorsal fin originates at a distance from end of snout which nearly equals height of body and its entire length. Second dorsal spine strong and produced into a filament, about as long as body. Third spine 1.3 to 1.7 in head. Third spine of anal 2.3 to 2.5; first ray 2.3 to 2.7. Caudal forked; least depth of caudal peduncle 2.5 to 2.8; ventral 1.3; pectoral 1.5 to 2.3 in length of body.

Back pale brown, with ten to twelve pale dusky vertical lines, often broken as a series of dark blotches. Snout edge and upper lip dusky. Row of dark spots on soft dorsal, one on each membrane below middle and concealed by basal sheaths.

Habitat.—China, Queensland, Melanesia, Indo-China, East Indies, Penang, Ceylon, Red Sea, Portuguese East Africa, Madagascar, and Philippines.

The above description is based on No. 15152, 152 mm, from Lake Bombon, Batangas, March 23 to April 8, 1927.

LUZON, Ilocos Sur Province, Vigan, No. 11977, 62 mm, January 3, 1923: Pangasinan Province, Agno River, Nos. 676, 677, 65 to 84 mm, July 18, 1907; Bulacan Province, Santa Cruz,

Paombong, No. 24066, 115 mm, April 27, 1927: Rizal Province, Malabon, No. 747, 86 mm, July 18, 1907: Pampanga Province, Lubao, No. 15996, 123 mm, April 30, 1927; Macabebe, Pilipit, No. 15323, 61 mm, May 7, 1927: Zambales Province, Iba, No. 11952, 95 mm, October 26, 1921; Subic Bay, No. 15144, 165 mm, April 19, 1927: Manila, Manila Bay near Limay, Nos. 15655, 24069, 101 to 102 mm, November 18, 1927; Manila, No. 112, 98 mm, June 1, 1907; No. 958, 143 mm, September 1907; No. 272, 120 mm, June 14, 1907: Batangas Province, Batangas, No. 2219, 67 mm, January 16, 1908; Limbones, Nos. 24076, 2205, 24077, 35 to 38 mm, January 14, 1908; Pancipit, San Nicolas, No. 12966, 55 mm, January 9, 1926; No. 15152, 104 mm, April 8, 1927; Nasugbu, Barrio Papaya, No. 13051, 65 mm, January 3, 1926: Albay Province, Legaspi, Yawa River, Nos. 1331, 13380, 24113, 24115, 24114, 34 to 76 mm, February 7, 1926: Camarines Sur Province, San Miguel Bay, Nos. 24079, 11888, 73 to 88 mm, February and March, 1922: Sorsogon Province, Bulan, No. 3221, 112 mm, 1904. MINDORO, Mindoro Province, Naujan, Butas River, Nos. 15257, 24071, 15432, 64 to 103 mm, August 10, 1927; Mangarin, Nos. 24072, 9605, 24070, 68 to 172 mm, 1913. NEGROS, Negros Oriental Province, Zamboanguita, No. 2408, 89 mm, March 13, 1922. SAMAR, Samar Province, Catbalogan, No. 1239, 68 mm, September 4, 1907; Basey, San Pedro Bay, No. 12355, 73 mm, September 17, 1925. PANAY, Iloilo Province, Dumangas, No. 9959, 103 mm, June 2, 1922; Iloilo, No. 10051, 102 mm, May 1922: Capiz Province, New Washington, No. 12725, 77 mm, August 6, 1925: Antique Province, San Jose, Nos. 24090, 24091, 24092, 13147, 57 to 79 mm, February 1926. GUIMARAS, Iloilo Province, Guimaras, No. 41335, 98 mm, December 18, 1933. PALAWAN, Palawan Province, Tagbanua, Nos. 15496, 24074, 78 to 100 mm, June 1, 1927. CULION, Palawan Province, Culion, Nos. 6189, 6210, 6188, 32 to 85 mm, October, 1910. PALAWAN, Palawan Province, Puerto Princesa, No. 1971, 59 mm, 1910. MINDANAO, Agusan Province, Agusan River, No. 1477, 68 mm, September 8, 1907: Zamboanga Province Zamboanga, Nos. 24078, 2971, 110 to 113 mm, April 13, 1908; No. 2903, 48 mm, April 10, 1908, Nos. 4459, 4460, 90 to 95 mm, June 16, 1908: Davao Province, Davao, No. 3127, 65 mm, April 20, 1908; No. 24138, 88 mm, April 23, 1908; No. 3385, 55 mm, April 24, 1908; Nos. 3294, 24075, 35 to 73 mm, April 23, 1908; No. 3404, 70 mm, April 25, 1908: Surigao Province, Gigaket, Nos. 27629, 9985, 100 to 110 mm, June 5, 1922.

We have the following foreign examples: CHINA, Hongkong, No. 6564, 88 mm; No. 6572, 55 mm, August, 1910; Hoichow, Hainan, No. 27631, 79 mm; No. 27632, 66 mm, No. 27630, 73 mm; No. 10104, 75 mm, 1922. BORNEO, Sandakan, No. 2451, 67 mm, No. 2564, 65 mm; No. 2588, 70 mm, February, 1908.

GERRES KAPAS Bleeker. Plate 2, fig. 2.

Gerres kapas BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1851) 482; 3 (1852) 161; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 352; CASTO DE ELERA, Cat. Fauna de Filipinas 1 (1895) 477; WEBER, Siboga-Exp. 65 (1913) 271; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 art. 2 (1922) 41; FOWLER, Proc. Acad. Nat. Sci. Phila. (1927) 284; Mem. B. P. Bishop. Mus. 10 (1928) 225; Proc. Acad. Nat. Sci. Phila. [1929 (1930)] 647.

Diapterus kapas BLEEKER, Atlas Ichth. Ind. Neerland. 8 (1876-77) 127, pl. (77) 361, fig. 3.

Xystaema kapas EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 70; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 244; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 260; SEALE, Philip. Journ. Sci. § D 5 (1910) 278.

Xystaema baconensis (part) EVERMANN and SEALE, Bull. Bur. U. S. Fish. 26 (1906) 70; FOWLER, Copeia No. 58 (1918) 64; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 6 (1931) 348-349.

Dorsal IX, 10; anal III, 7; scales in lateral line 40; transverse series 15.

Body oblong, dorsal profile elevated and compressed at origin of dorsal. Depth 2.5 to 3; head 3 to 3.2; snout 3 to 3.3 in head; eye about 3 to 3.5 in head. Maxillary reaches to below anterior third of eye; mandibular profile slightly concave; teeth fine, villiform, in bands in jaws; gill rakers 5 + 8, lanceolate, about 0.25 to 0.5 of gill filaments or 3 to 4 in eye; upper three rudimentary. Preoperculum entire, with rounded angle. Scales more or less crenulate. Distance of dorsal origin from end of snout greater than height of body and less than length of dorsal; 18 to 20 predorsal scales, forward opposite front of eye edge; premaxillary groove broadly naked; three rows of scales on cheek to preopercular ridge. Scales with six to eight basal radiating striæ; fine circuli very largely parallel and vertical. Second spine of dorsal 1.3 to 1.7 in head, first ray 2.8 to 3; least depth of caudal peduncle 2.3 to 2.7; ventral 1.7; pectoral 3 to 3.3 in combined head and trunk to caudal base.

Color silvery, tip of spinous dorsal black; body without longitudinal darker lines.

Habitat.—East Indies, Siam, Polynesia, east coast of Africa, and Philippines.

The above description is based on No. 3418, 129 mm, Bacon, Sorsogon, 1904.

LUZON, La Union Province, Camp Wallace, San Fernando, No. 907, 75 mm, August, 1907; Batangas Province, Limbones Cove, No. 2204, 38 to 52 mm, January 14, 1908. BOHOL, Bohol Province, Inabanga, Nos. 14692, 24083 76 to 115 mm, December 3, 1926. CUYO, Palawan Province, Cuyo, No. 2049, 67 mm, October 1, 1907. MINDANAO, Surigao Province, Placer, No. 1789, 48 mm, September 17, 1907. SAMAL, Davao Province, Samal, No. 3901, 47 mm, May 4, 1908. SITANKAI, Sulu Province, Sitankai, No. 4546, 89 mm, June 20, 1908; No. 4579, 78 mm, July 2, 1908.

We have the following foreign examples: GUAM, No. 7001, 72 mm; No. 7003, 7 mm, No. 7004, 76 mm, No. 6999, 81 mm, No. 6997, 63 mm; No. 7005, 83 mm; No. 6998, 61 mm; No. 7000, 87 mm; No. 7002, 127 mm; No. 7006, 83 mm; No. 7007, 61 mm, September, 1911. BORNEO, Sandakan, No. 2537, 66 mm, February, 1908.

GERRES OYENA (Forskål). Plate 2, fig. 3.

Labrus oyena FORSKÅL, Descript. Animal. (1775) 35; BLOCH, Schneider, Syst. Ichth. (1801) 245.

Smaris oyena RÜPPELL, Atl. Reise Nördl. Afrika, Fische (1828) 11.

Gerres oyena CUVIER and VALENCIENNES, Hist. Nat. Poiss. 6 (1830) 472; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 353; 4 (1862) 261; PLAYFAIR, Fishes of Zanzibar (1866) 111; DAY, Fishes of India 4^o. (1878-88) 99; MACLEAY, Descr. Cat. Austral. Fish. 1 (1881) 78; MEYER, Anal. Soc. Española Hist. Nat. Madrid 14 (1885) 18; DAY, Fauna Brit. India 2 (1889) 538; SAUVAGE, Hist. Nat. Madagascar, Poiss. (1891) 243, pl. 36A, fig. 2; CASTO DE ELERA, Cat. Fauna Filip. 1 (1895) 560; WEBER, Siboga-Exp. 57 (1913) 273; FOWLER, Mem. B. P. Bishop. Mus. 10 (1928) 225; Proc. Acad. Nat. Sci. Phila. (1931) 247.

Diapterus oyena BLEEKER, Atlas Ichth. Ind. Neerland. 8 (1876-77) 129.

Xystaema oyena SMITH and POPE, Proc. U. S. Nat. Mus. 31 (1906) 478; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1908) 244; SEALE, Philip. Journ. Sci. § D 5 (1910) 278; FOWLER, Copeia No. 58 (1918) 64.

Xystaema erythroum JORDAN, Proc. U. S. Nat. Mus. 32 (1907) 246, fig. 1; SNYDER, Proc. U. S. Nat. Mus. 42 (1912) 416; FOWLER, Proc. Acad. Nat. Sci. Phila. (1929) 647.

Gerres erythroum JORDAN and HUBBS, Mem. Carnegie Mus. 10 No. 2 (1925) 242.

Gerres oblongus BLEEKER, Natuur. Geneesk. Arch. Ned. Ind. 2 (1845) 521.

Gerres acinaces BLEEKER, Nat. Tijdschr. Ned. 6 (1854) 194; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 351; DAY, Proc. Zool. Soc. London (1870) 698; SAUVAGE, Hist. Nat. Madagascar, Poiss. (1891) 245; FOWLER, Proc. Acad. Nat. Sci. Phila. (1925) 245; Mem. B. P. Bishop. Mus. 10 (1928) 224.

Diapterus acinaces BLEEKER, Atlas Ichth. Ind. Neerland. 8 (1876-77) 126 pl. (77) 361, fig. 2.

Diapterus filamentosus BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 231.
Gerres lineolatus PLAYFAIR, Fishes of Zanzibar (1866) 110, pl. 16, fig. 2.

Gerres splendens WHITLEY, Mem. Queensland Mus. 10 (1930) 15, pl. 1, fig. 1.

Dorsal IX, 10; anal III, 7; scales in lateral line 36 to 38; transverse series 15 to 17.

Body oblong, rostrrodorsal profile rounded; height 2.5 to 2.8; head 3 to 3.3; eye 3 to 3.3 in head, equal to or somewhat less than interorbital space, which is scaleless, in its middle; snout about equal to eye or shorter. Maxillary reaching slightly behind front border of eye; mandibular profile slightly concave. Gill rakers 6 + 7, short points, 2.3 in gill filaments, which is 0.5 of eye. Scales thin, deciduous, with seven to nine basal radiating striæ and as many as six incomplete auxiliaries; circuli very fine; twenty-two to twenty-four predorsal scales forward nearly to nostrils leaving broad scaleless premaxillary groove in front of interorbital; three or four rows on cheek to preopercular ridge. Preoperculum entire, its angle rounded. Lower pharyngeal bones united by a mobile suture, covered by conical or tubulate small teeth, becoming somewhat longer towards median line. Distance from end of snout to origin of dorsal greater than height of body, but less than length of dorsal. Second dorsal spine 1.3 to 1.7 in head, 2 to 2.8 in depth, first ray 2.5 to 2.8; caudal widely forked; least depth of caudal peduncle 2.9 to 3; ventral 1.3 to 1.6; pectoral 3 to 3.3 in length. Color silvery, darker above; spinous dorsal with a blackish margin. Each membrane of dorsal basally with brown spot partly concealed by basal scaly sheath of fin. Slightly dusky at base of anal.

Habitat.—Singapore, Sumatra, Java, Borneo, Celebes, Red Sea, Zanzibar, Mauritius, Madagascar, British India, Japan, Australia, Caroline Islands, Guam, and the Philippine Islands.

SAMAR, Samar Province, Catbalogan, No. 1110, 54 mm, September 2, 1907. BANTAYAN, Cebu Province, Bantayan, Nos. 5928, 5934, 5936, 5939, 5942, 3943, 24073, 28 to 30 mm, May,

1909. PANAY, Iloilo Province, Estancia, Nos. 24108, 11841, 73 to 85 mm, February 11, 1925. CUYO, Palawan Province, Cuyo, No. 1993, 107 mm, October 1, 1907. PALAWAN, Palawan Province, Puerto Princesa, No. 5398, 45 to 47 mm, August 19, 1908. MINDANAO, Cagayan Province, Cagayan, No. 1584, 122 mm, September 12, 1907; No. 1668, 118 mm, September 13, 1907; Zamboanga Province, Zamboanga, No. 4440, 123 mm, June 15, 1908; Caldera Bay, No. 4043, 49 to 54 mm, May 20, 1908. BILATAN, Sulu Province, Bilatan, No. 11353, 204 mm, July 29, 1924. SITANKAI, Sulu Province, Sitankai, No. 4849, 102 mm, July 17, 1908; No. 4585, 68 mm, July 3, 1916; Tubigan, No. 13787, 62 mm, March, 1926.

We have the following foreign example: BORNEO, Sandakan, No. 2609, 85 mm, February, 1908.

GERRES OBLONGUS Cuvier and Valenciennes. Plate 3, fig. 1.

Gerres oblongus CUVIER and VALENCIENNES, Hist. Nat. Poiss 6 (1830) 361; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 354; 4 (1862) 264; DAY, Fishes of India 1 (1878) 98, pl. 25, fig. 2; Fauna Brit. India 1 (1889) 536; Siboga-Exp. 65 (1913) 272; FOWLER, Proc. Acad. Nat. Sci. Phila. (1925) 244.

Gerres gigas GÜNTHER, Cat. Fish. Brit. Mus. 4 (1862) 262; Journ. Mus. Godeffroy 2 and 3 (1874) 30, pls. 5, 6, 24, fig. A; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 226.

Gerres macrosoma KNER, Sitzungsber. Akad. Wiss. Wien. 53 (1868) 301.

Gerres carinatus ALLEYNE and MACLEAY, Proc. Linn. Soc. New South Wales 1 (1876) 273, pl. 7, fig. 4.

Gerres oblongus DAY, Fishes of India 4°. (1878-1888) 98.

Dorsal IX, 10; anal III, 7; scales in lateral line 45 to 48; transverse series 17.

Body oblong, height 3 to 3.1 in length, about equal to length of head, which is pointed. Head 3.2; eye 3.3, equal to snout and naked interorbital space. Maxillary reaching to below front border of eye, length 2.8 to 3 in head; profile of mandibula slightly concave. Interorbital 3.5 to 3.7 broad, and little convex. Gill rakers 4 + 8, short points, 0.5 of gill filaments, which is 4.4 in eye. Preoperculum entire and rounded. Distance of dorsal origin to end of snout much less than length of entire dorsal and more than 0.2 longer than height of body; twenty-two to twenty-five predorsal scales extending anteriorly to opposite front eye edge, premaxillary groove broad, naked; three rows of scales on cheek to preopercle ridge. Scales with five basal radiating striæ; basal circuli are fine parallel transverse striæ. Second dorsal spine rather strong and elongate,

1.5 to 2 in head, first ray 3 to 3.3. Second anal spine the strongest, nearly 3 in head, first ray 3; least depth of caudal peduncle 3.7 to 4; pectoral equal head, longer in young; ventral 1.8; caudal 1 to 1.1, deeply forked. Back pale brown, with purplish shades. Sides and lower parts white with silvery white shades. Fins all pale, membranes of spinous dorsal dusky at end and each membrane with dusky spot basally, mostly concealed by basal scaly sheath.

Habitat.—New Guinea, Portuguese East Africa, India, Ceylon, Andamans, East Indies, Queensland, Polynesia, and Philippines.

The above description is based on No. 11437, 128 mm, Calapan, Mindoro, January 17, 1923.

LUMBUCAN, Palawan Province, Nos. 24095, 24097, 61 to 83 mm, January 17, 1923; Nos. 24093, 24101, 24096, 24102, 24100, 15671, 24098, 24094, 24099, 12596, 24117, 52 to 188 mm, November 14 to 29, 1927. CUYO, Palawan Province, Cuyo, No. 2047, 56 mm, October 1, 1907. MINDANAO, Zamboanga Province, Zamboanga, Nos. 4325, 4326, 24068, 24067, 41 to 77 mm, June 3, 1908. SAMAL, Davao Province, Samal Island, No. 3731, 33 mm, May 1, 1908.

GERRES BACONENSIS (Evermann and Seale). Plate 3, fig. 2.

Xystaema baconensis EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 69, fig. 8.

Gerres baconensis FOWLER, Bull. U. S. Nat. Mus. 100 pt. 12 (1933) 245.

Dorsal IX, 10; anal III, 6; scales in lateral line 40 to 42; transverse series 14 to 15.

Depth 2.5; head 3.1 to 3.3; snout 3.1 to 3.2 in head; eye 3.2 to 3.33, greater than or almost equal to snout, 1.1 to 1.3 in interorbital; maxillary reaches level of front pupil edge. Teeth villiform, in narrow bands in jaws; interorbital 2.5 to 2.8, slightly convex, with a median depression; groove with scales, with only small median circular area, but half of pupil in diameter. Gill rakers 5 + 6, short points about 0.5 of gill filaments. Cheek with four rows of scales to preopercle ridge. Scales with five to eight basal radiating striæ; circuli very fine. Predorsal scales twenty-four to twenty-six, until about nostrils. Second spine of dorsal 1.3 to 1.5 in head; first ray 2.8 to 3. Third spine of anal 2.5 to 3, first ray 2.5 to 2.8 least depth of caudal peduncle 2.6 to 2.8, ventral 1.3 to 1.7; pectoral 3.1 to 3.2.

Back brown, with bright lilac and silvery reflections. Lower sides silvery white. Lips pale or whitish, spinous membranes dusky to even blackish at edge; each membrane pale brown basally, partly concealed by basal scaly sheaths. Anal with brown dots anteriorly.

Known only from the Philippine Islands.

The above description is based on No. 1106, 128 mm, Catbalogan, Samar, September 2, 1907, the only example of *Gerres baconensis* in the collection. The fish tallies with the description given by Fowler, but no scales are found on the premaxillary groove.

GERRES MACROSOMA Bleeker. Plate 3, fig. 3.

Gerres macrosoma BLEEKER, Nat. Tijdschr. Ned. Ind. 6 (1854) 56; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 353; 4 (1862) 263; DE BEAUFORT, Bijd. Dierk. Amsterdam 19 (1913) 121; FOWLER, Proc. Acad. Nat. Sci. Phila. (1923) 41; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 224.

Diapterus macrosoma BLEEKER, Atlas, Ichth. Ind. Neerland. 8 (1873-1877) 126, pl. (78) 362, fig. 5.

Xystaema macrosoma JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [(1905) 1906] 272.

Dorsal IX, 10; anal III, 7; scales in lateral line 42 to 43; transverse series 16.5 to 17.

Body oblong, with rostrrodorsal profile slightly convex with a very small median concavity anterior of eye; the bordering scales reaching nostrils; height 3 to 3.1; head 3 to 3.2 in length. Eye 3 to 3.2 in head, equal to interorbital space and to snout. Maxillary reaching anterior margin of eye; mandibular profile straight, length 2.5 in head, teeth fine, in moderate bands in jaws; interorbital 3.3. Gill rakers 6 + 7, lanceolate, 0.4 of gill filaments; upper four rudimentary. Distance of dorsal origin to end of snout much greater than height of body but less than entire length of dorsal. Second dorsal spine the longest, 1.5 to 1.6 in head, first ray 3 to 3.5; second and third anal spines subequal, 2 in second dorsal spine and about equal to eye. Pectorals equal head and about equal to depth of body; ventrals 2 in pectorals. Upper lobe of caudal about equal to length of head. Caudal deeply forked, with least height of caudal peduncle less than its length. Pale brownish on back, sides and below silvery whitish; iris grayish; spinous dorsal with a blackish margin.

Habitat.—East Indies, Philippines, Melanesia, Micronesia, Polynesia, and Hawaii.

The above description is based on No. 4325, 77 mm, Zamboanga, June 3, 1908.

MINDORO, Mindoro Province, Calapan, No. 11984, 115 mm, January, 1921. BANTAYAN, Cebu Province, Bantayan, Nos. 24104, 24106, 24105, 16323, 24107, 24103, 113 to 145 mm, January 2, 1929. CEBU, Cebu Province, Cebu, No. 1927, 114 mm, September 27, 1907. COMIRAN, Palawan Province, Comiran, No. 15631, 60 mm, November 17, 1927. LUMBUCAN, Palawan Province, Lumbukan, Nos. 15672, 24116, 24118, 24119, 24120, 24121, 24122, 24123, 24124, 24125, 24126, 24127, 24128, 24129, 24130, 24131, 24132, 24134, 24135, 24136, 24137, 29 to 90 mm, November 14, to 29, 1927. PALAWAN, Palawan Province, Puerto Princesa, No. 5384, 77 mm, August 19, 1908. CUYO, Palawan Province, Cuyo Island, No. 2048, 58 to 60 mm, August 1, 1907. SIKUIJOR, Oriental Negros Province, Lazi, No. 1368, 65 mm, September 6, 1907. MINDANAO, Zamboanga Province, Zamboanga, Nos. 2023, 4421, 55 to 70 mm, April 14, 1908: Davao Province, Davao, No. 3508, 64 mm, April 29, 1908. JOLO, Sulu Province, Jolo, No. 24088, 58 to 72 mm, March, 1926. SITANKAI, Sulu Province, Sitankai, No. 4643, 77 mm, July 5, 1908.

ILLUSTRATIONS

[Drawings by A. Lagman. The scale line beside each fish represents 2 centimeters.]

PLATE 1

- FIG. 1. *Mene maculata* (Bloch and Schneider).
2. *Gerres abbreviatus* Bleeker.

PLATE 2

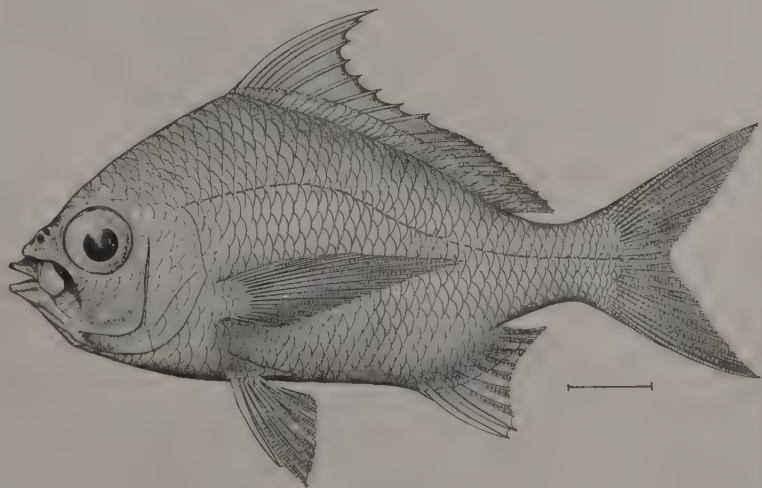
- FIG. 1. *Gerres filamentosus* Cuvier.
2. *Gerres kapas* Bleeker.
3. *Gerres oyena* (Forskål).

PLATE 3

- FIG. 1. *Gerres oblongus* Cuvier and Valenciennes.
2. *Gerres baconensis* (Evermann and Seale).
3. *Gerres macrosoma* Bleeker.



1



2

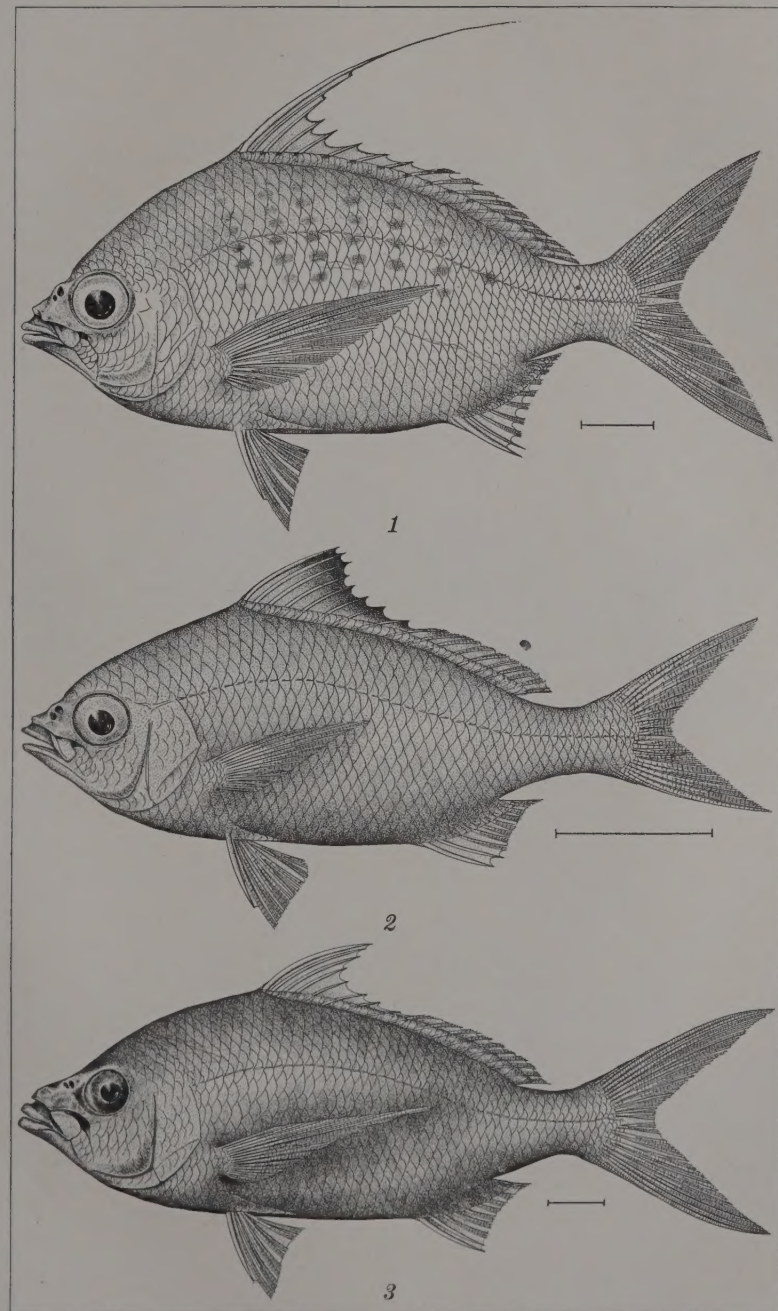


PLATE 2.

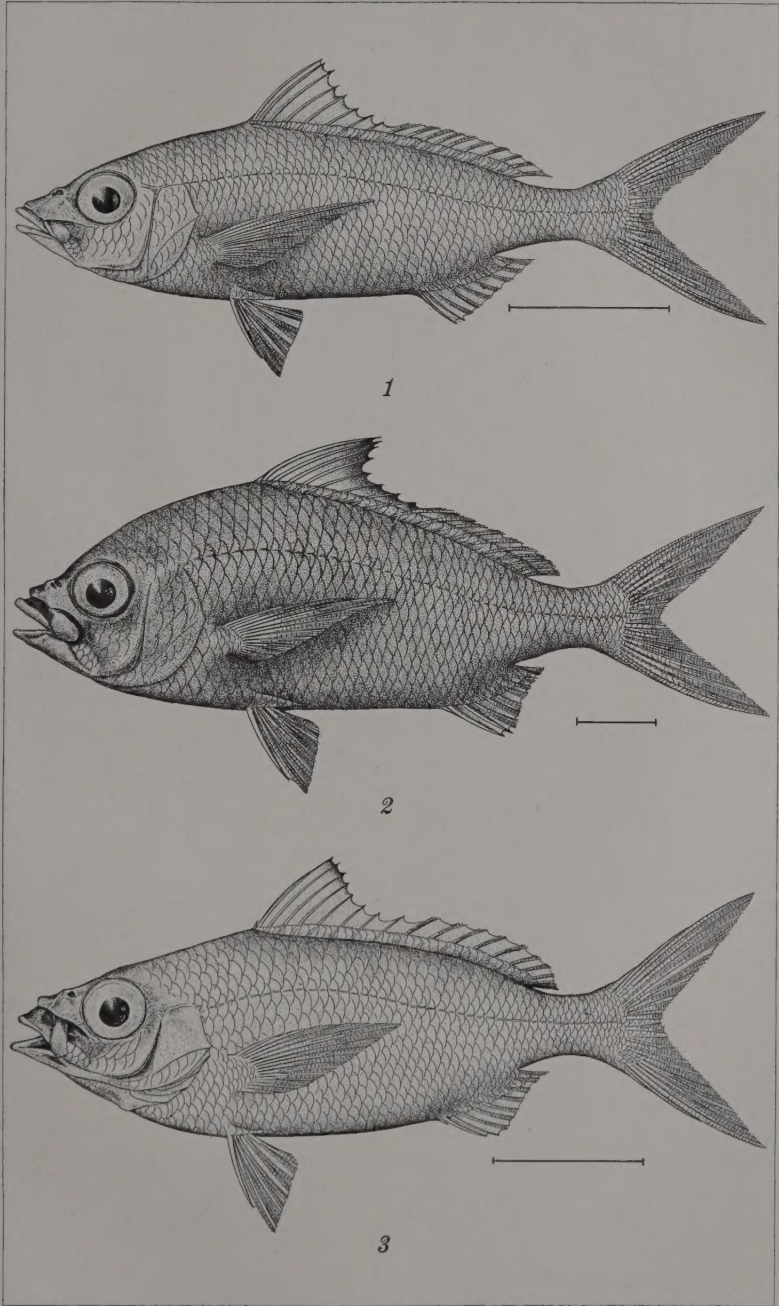


PLATE 3.

